POWER

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PHILIP W. SWAIN, *Editor*

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THE ENGINEER'S PHILOSOPHY

1. I AM AN ENGINEER because I am mechanically inclined and enjoy applying what brains and experience I have to a practical job essential to the life of the community.

2. FOR MYSELF, I hope to get out of it also a decent living, the satisfaction of a job done right, and the respect of my associates.

3. I AM ENGAGED IN WORK which places small value on window dressing; in the long run an engineering job cannot be bluffed.

4. A DECENT "FRONT," however, is proper and is expected of me as long as I can back it up with results.

5. I SHALL BE JUDGED first by my ability to deliver dependable power services: electricity always on tap at constant voltage and frequency, steam delivered to process at the right pressure and temperature, water available when and where needed and as hot or cold as required, heating so perfect that you don't notice it.

6. I SHALL ALSO BE JUDGED by the cost of these services. I shall watch this always, keep complete records for the dual purpose of making the cost low and of proving that it **is** low.

7. IF THE MANAGEMENT REFUSES to measure my value by the cost and quality of the power services I produce, I shall look for another job, for I cannot afford to be permanently identified with an organization not intelligently directed.

8. TO INSURE BEST POWER SERVICES at the lowest cost, I shall consider at all times men, machines and money.

9. THE MEN I HIRE must be competent, dependable, intent on results. I must earn their confidence. They must know that merit—and only merit—will win reward.

10. I SHALL TRAIN MEN to meet emergencies, to use their heads at all times. I shall encourage them to work for advancement.

11. I MUST KEEP MANAGEMENT constantly alive to the importance of power problems and **power results.**

12. I EXPECT TO BE RESPONSIBLE for power results and to be given the authority that must always go with responsibility.

13. I SHALL STUDY POWER EQUIPMENT and hookups constantly to see how they can be used to cut power costs or improve service, and I shall act where action is clearly indicated.

14. I SHALL NEVER MAKE a power decision without considering cost—first cost and operating cost.

15. I SHALL BUILD a power plant organization which will work as a team to set new low records for the unit costs of electricity, steam and other power services.

16. AND I SHALL MAKE certain that management watches the scoreboard.

HEAT FLYWHEEL

ASIDE from making cheaper steam, the main trick in generating cheap industrial power is to eliminate waste of heat to atmosphere or condensers. That's the story of "heat balance"—worth memorizing.

Sometimes it's hard to accomplish, because heat and power loads are out of balance. But where processes use much hot water a "heat flywheel" may solve this problem. During periods of excess power load, water is heated with surplus exhaust steam and stored in insulated tanks for later process use.

See page 561 for the story of a dye house that eliminates waste exhaust in this way and thus produces power for $0.004 per kw.-hr. including all fixed charges.

BAYWAY

"GREAT oaks from little acorns grow." Starting back in 1908 with a few small engines and a battery of H.R.T. boilers, the Bayway refinery of the Standard Oil (N.J.) has acquired step-by-step a magnificent power plant to serve its 1,800 acres of modern refining equipment. Notable features are 25,000 kw. of generating capacity, a 5,000-hp. pumping station, successful firing of worst types of refinery waste.

Power's story of this evolution (page 539) will interest every engineer, because it tells *why* Bayway grew that particular way—shows how step-by-step modernization works out in practice. Incidentally the generation of steam at 650 lb. pressure in this plant is still another indication that pressures above 400 lb. are becoming "standard" in certain process industries —notably oil refining, paper and rubber.

PRACTICAL

ANOTHER great research job—very different from steam-table research in object and method—is being lined up by the joint S.A.E.-A.S.M.E. Diesel Fuel Committee. Engine builders and users and oil companies face a puzzler. None of them can tell in advance just how a given oil will act in a given engine. Will it knock? How will it ignite? Because they are never quite sure, standardization of diesel-oil specifications is still impracticable.

This job simply cannot be tackled like a steam research project. Steam is simple. Its heat properties are subject to exact definition and precise measurement. Hence the proper approach is that of the hair-splitting physical laboratory. But knock, ignitibility and other so-called "properties" of engine oils are fickle as a March wind; you can't pin them down. The call is for research work of the shovel-and-crowbar variety with an eye to immediate practical results at lowest cost. Preliminary plans of the Committee show a thoroughly practical approach.

SUN POWER

RECENTLY the editor lunched with Prof. Colin G. Fink, Columbia University's internationally known expert in electro chemistry. The newspapers had announced Prof. Fink's 25 per cent improvement in the efficiency of the photo-voltaic cell which produces electricity directly from sunlight. They hinted that commercial generation of electricity from sunlight is "just around the corner."

Prof. Fink, however, makes no such broad claim, although "anything is possible." For one thing, the 25 per cent improvement still leaves cell efficiency at a microscopic fraction of one per cent. Noon sunlight delivers more than a kilowatt to each square yard of Earth's surface, but the best photo-voltaic cells of today can convert only a few flea-power of it. Even so, they have many practical applications.

As far as power generation is concerned, the photo cell may have its place in the distant future when fuels run low and the problem of cheap power storage has been solved to take care of nights and cloudy days.

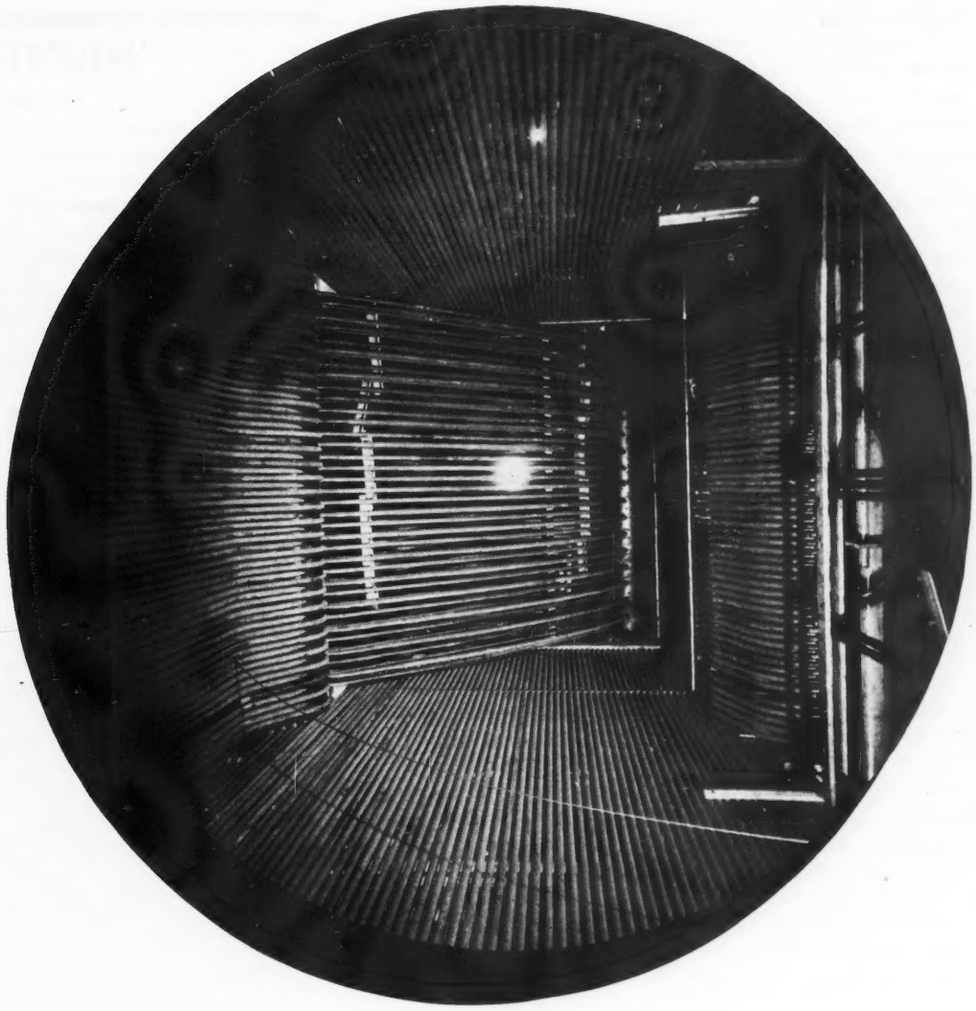
ECONOMICS WILL WIN

IT MAY BE human nature for some operating engineers to attempt to "save" uneconomical local generating equipment against the competition of purchased energy. It may also be human nature for some utility power salesmen to attempt to sell to plants that can generate their own power more cheaply. These attempts may succeed temporarily—often do—but in the long run economics must win. Why fight the inevitable? As time goes on more and more plants must gravitate to the particular setup that gives the factory owner his power services at the lowest overall cost.

All fairminded men familiar with power cost problems know perfectly well that both purchased power and locally generated power have immense "natural" fields in industry. They know also that any artificial disturbance of this natural division merely increases manufacturing costs and thus tends to correct itself through the processes of business competition.

POWER STANDS FOR

1. Making power when it should be made
2. Buying power when it should be bought
3. Cheaper power through modern equipment
4. Easier financing of equipment purchases
5. Better use of by-product heat and power
6. Operating methods that save money
7. Less waste in transmission and application
8. Prevention of smoke, within reason



BAYWAY MARCHES ON

By OTTO LESSING
Mechanical Engineer,
Standard Oil Co. of N. J.

BY THE end of 1934 the Standard Oil Company of New Jersey will have completed another step in the modernization of the steam and power generating facilities at its 1,800-acre Bayway Refinery at Linden, N. J., one of the world's largest. This latest step will bring total generating capacity of the plant to the imposing total of 25,000 kw. and 500,000 lb. of 650-lb. steam per hr.

Starting in 1908 with a battery of puny H.R.T. boilers operating at 100 lb. pressure, Bayway offers a spectacular case history to the student of step-by-step modernization. The total load at Bayway Refinery has grown without interruption, ever since ground was broken in 1907.

In addition to gasoline, the present refinery produces not only gasoline, fuel oils and lubricating stocks, but many other petroleum products, including various alcohols and solvents, insecticides, and pharmaceutical preparations. All of the many processes require an ample and reliable supply of power and steam. Most of them require also liquid and gaseous fuels, water, chemicals and compressed air. The present power load is about 15,000 kw.

In 1926 engineers of the company realized the economy of producing by-product power with high-pressure turbine-generators. Since that time a gradual modernization program has moved ahead to concentrate the steam-generating capacity in a few efficient high-pressure units of ample overload capacity, abandon virtually all low-pressure boilers and so balance steam and power requirements that only a small fraction of the power need be generated in condensing units.

This year's notable step was the starting up of a 300,000-lb. per hr. 650-lb. pressure steam-generating unit, the second designed for this pressure at Bayway,

and the sixth now in operation there above 175 lb.

Bayway's history reflects the progress of industrial power as well as of petroleum refining. When the refinery was first built, 100 lb. steam pressure was considered adequate for all purposes, and the use of electric power was not given a thought. It would be interesting to know what thoughts prompted the engineers who built the boiler shop at Bayway to place a coal-fired vertical boiler and a steam engine in the cab of the shop crane as a means of motive and hoisting power. The engineers soon realized their mistake, however, and moved boiler and engine to the shop floor, belted the engine to a 65-kw. generator and installed motors in the crane. The following year the first battery of stills was placed in operation, and the same generator provided brilliant illumination in the receiving houses and on the towers of the stills.

To supply the first stills and their dewaxing equipment 30 coal-fired H.R.T. boilers were in operation by the end of 1908. Some additional motor-driven equipment had also been installed, and two marine-engine-driven 250-kw., 25-cycle, generators were added to supply this load.

Between 1908 and 1912

Shortly thereafter the problem which now confronts every refinery engineer arose for the first time. An excess of petroleum gas had to be disposed of; more power was needed and steam-generating capacity was limited. Three 400-kw. gas-engine sets were a temporary solution. Later additional boilers were installed, and the next increase in power load was taken care of by a 500-kw. condensing turbine, installed in 1912. Further increases in waste-gas production resulted in the installation of an 800-kw. gas engine unit soon afterwards. A 1,000-kw. turbine-generator unit followed in 1914.

By 1921 the average steam load had grown to 1,000,000 lb. per hr. and the power load was a little over 1,000 kw. Seventy-two H.R.T. boilers were in operation, all fired by coal or gas. Much of the steam was used to pump the great quantities of water used by the stills from the Arthur Kill through more than a mile of pipeline. Here, the management decided, was the logical place to start a program of modernization. In an entirely new boiler and power house were installed four 17,600 sq.ft., 175-lb. pressure, Bigelow-Hornsby boilers, equipped with chain-grate stokers for burning anthracite, two 3,750-kva., 6,600-volt, 60-cycle, mixed-pressure condensing turbines and two 850-kva. frequency changers. The 1,000-kw., 25-cycle turbine was also moved to the new plant from the old power house.

A new water-front pumping station was built with five 25,000-g.p.m. centrifugal pumps driven by 1,000-hp., 6,600-volt synchronous motors. A double-circuit power line on steel towers connected the pumping station and the new power house, and a new 60-in. cast-iron water line supplied the refinery. The equipment went into operation in 1922 and made it possible to retire most of the H.R.T. boilers and the inefficient generator units.

By 1924 the plant was burning 550 tons of coal per day on the chain-grate stokers at the new boiler house. Once more the problem of disposing of heavy refinery wastes became acute. No satisfactory burners were available for handling acid tars, sludges and tank bottoms, so these materials were mixed with the anthracite in the coal-storage pit and the mixture was then burned on the chain grates. As might be expected with waste fuels of such high acid content, maintainence on stokers, settings, boilers, flues, fans and stacks was excessive.

In 1926 additional refinery equipment was being installed, increases in steam and power loads were imminent, and more and more heavy wastes were being produced which had to be burned. A second power station was built about half a mile from the central power house. Four 7,600-sq.ft., 400-lb. pressure boilers were installed and one 5,000-kva. turbine-generator, designed to operate at 125-lb. back pressure. Furnaces were fired by sludge and gas. The steam-atomizing sludge burners fired downward through an arch in the front of the furnace to permit long flame travel and give ample time for the heavy wastes to burn. For a number of years this was the only manner in which these fuels could be burned successfully. When one considers that many of the sludges must be kept at over 250 deg. F., must be pumped at pressures as high as 250 lb., have an acid and water content as high as 30 per cent, and are constantly changing in consistency, one can appreciate the difficulty of operating high-pressure boilers with such a fuel.

MILESTONES

1908

Refinery started operation with 30 coal-fired H.R.T. boilers, 100 lb. pressure. Two 250-kw. generators driven by marine engines.

Between 1908 and 1912

Installed three 400-kw. gas engine sets operating on waste petroleum gas. Additional H.R.T. boilers installed.

1912

Installed 500-kw. condensing turbine set and an 800-kw. gas engine.

1914

Installed 1,000-kw. turbine.

1921 and 1922

72 H.R.T. boilers in operation. Decided to modernize. Installed four 17,600-sq. ft. water-tube boilers for 175-lb. pressure (with chain-grate stokers), 3,750-kva. mixed-pressure condensing turbines and two 850-kva. frequency changers. Built 5,000-hp. pumping station.

1926

Built a second power station with four 7,600-sq.ft. boilers for 400 lb. pressure, and one 5,000-kva. turbine, 125-lb. back-pressure. Boilers fired by sludge and gas.

1929

Installed another 5,000-kva., 125-lb. back-pressure turbine. Added water walls and tube economizers to four boilers.

1932

Added one 300,000 lb.-per-hr. boiler, 650 lb. pressure; one 9,375-kva. turbine exhausting 110-175 lb.

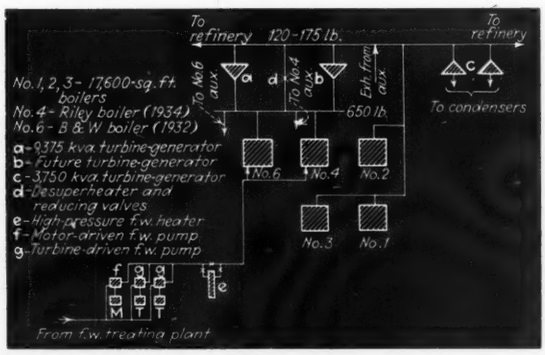
1934

Installed colloidal fuel preparation plant. Rebuilt three 17,600-sq.ft. boilers for gas and liquid fuel. Installed 300,000-lb. capacity, 650-lb. pressure boiler.

Installed pulverized coal and coke equipment for new boiler. Changed from 25-cycle to 60-cycle. Planned installation of another 650-lb. pressure turbine for 1935.

In 1929 further increases in steam and power loads were imminent, and a second 5,000-kva., 125-lb. back-pressure turbine was installed at the West Side Power House. The four boilers were also equipped at this time with water walls on all sides. Shortly thereafter the vertical-tube integral economizer sections, badly corroded by acids in the flue gases, were replaced with horizontal-tube economizers.

The operation of the West Side Power Station was so successful and the economy of generating power in high-back-pressure turbines so apparent that in 1931 construction of an addition to the Central Power Station was started. Completed in 1932, this addition consisted of one 300,000 lb.-per-hr., 650-lb. pressure boiler, and a 9,375-kva. turbine designed to exhaust at from 100 to 175 lb. pressure. Equipment was so connected that exhaust from the turbine could supply the condensing units in the station or flow into the yard mains. The boiler was of the straight-tube, single-drum type having a furnace arranged for sludge and gas firing, with turbulent-type steam-atomizing burners mounted in the front and rear walls. Side walls were cooled with refractory covered water tubes. This installation proved the feasibility of burning the heaviest types of refinery wastes in short-flame burners.


To refinery 120-175 lb.
To refinery
No. 1, 2, 3 - 17,600-sq.ft. boilers
No. 4 - Riley boiler (1934)
No. 6 - B & W boiler (1932)
a - 9375 kva. turbine-generator
b - Future turbine-generator
c - 3750 kva. turbine-generator
d - Desuperheater and reducing valves
e - High-pressure f.w. heater
f - Motor-driven f.w. pump
g - Turbine-driven f.w. pump
To No. 6 aux.
To No. 4 aux.
Exh. from aux.
650 lb.
To condensers
No. 6
No. 4
No. 2
No. 3
No. 1
From f.w. treating plant

Modernized plant operates at 650-lb. pressure. Steam capacity 500,000 lb. per hour. Power capacity 25,000 kw.

By 1933 the two high-pressure stations had definitely proved their value. The next step was to eliminate all low-pressure boilers except for standby service. The fuel situation had changed materially; mixing tank bottoms and sludges with anthracite for burning on chain grates was no longer the only method available; all wastes could now be burned in steam-atomizing burners. Also the price of fuel oil had gone up considerably, and at times market conditions might make it desirable to supplement the refinery waste fuels with bituminous coal rather than with marketable fuel oil, as had been done when fuel oil prices were lower. These were the governing factors in the design of the latest addition to steam-generating capacity.

Here, in brief, is the 1933-4 construction program:

1. Installation of a colloidal fuel preparation plant to make heavy refinery wastes suitable for burning in special steam-atomizing burners.

2. Removal of chain-grate stokers from three of the 17,600-sq.ft., 175-lb. boilers in the central power station and rebuilding the furnaces for burning liquid and gaseous fuels only.

3. Dismantling of one of the above boilers.

4. Installation of a 250,000-lb. continuous capacity (300,000-lb. max.), 650-lb.-pressure, steam-generating unit in the space formerly occupied by one of the 175-lb. boilers.

5. Installation of pulverized-coal equipment to enable the new boiler to carry full load on bituminous coal and petroleum coke.

6. Additions and modifications to fuel-handling and storage system to permit efficient handling of coal, heavy refinery wastes and ashes by equipment formerly used for anthracite.

7. Replacement of all 25-cycle by 60-cycle equipment.

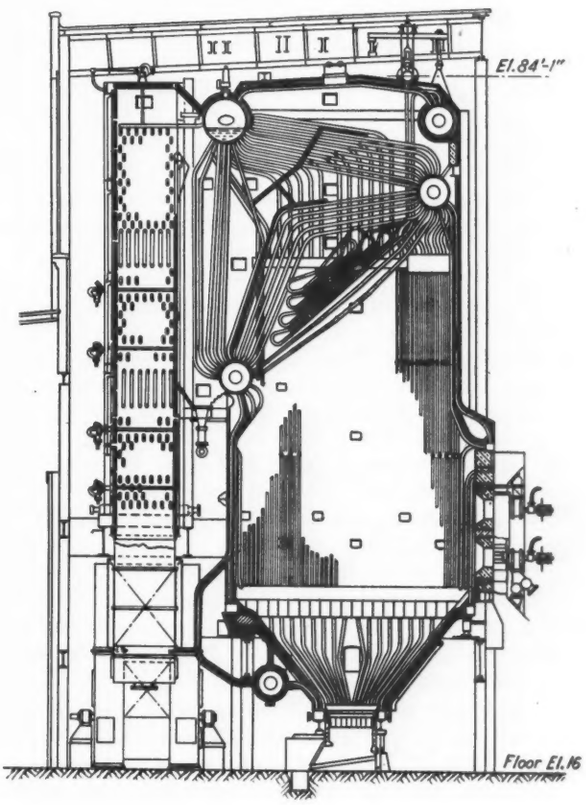
8. Preparation for installation of a second 650-lb. turbine in 1935.

The steam-generating unit installed this year, and now operating for several months, incorporates several unique features. It shows how older equipment can be replaced and the space utilized more than twice as effectively by modern high-capacity equipment.

The unit consists of a boiler having 15,000 sq.ft. of heating surface, four water walls and a water-cooled hopper bottom of 7,500 sq.ft. with a 14,100-sq.ft. economizer. Furnace volume is 17,000 cu.ft., assuring low maintenance and efficient combustion with low-grade waste fuels. To keep the installation as simple as possible no air heater was installed. The large economizer permitted reasonably high efficiency.

The 51-in. main steam drum is 2½ in. thick—a seamless forging of 75,000-lb. tensile steel. The other four drums are fusion welded. Adequate circulation in the water wall and hopper bottom tubes is assured by the

New boiler (1934) generates 300,000 lb. per hr. (max.) at 650 lb. pressure



32-in. diameter No. 5 drum. The superheater has 3,700 sq.ft. and is made of 36 2½-in. O.D. elements 157 ft. long. Water wall headers are rectangular and of seamless construction.

To facilitate external cleaning the horizontal-tube type economizer is divided into three sections. Each section is 14 tubes wide and 26 tubes high, the tubes being No. 6 gage, 2½-in. O.D., 40-ft. long bent into hairpin loops. Tubes are expanded into seamless forged-steel headers and are in parallel lanes, as experience has shown that when burning refinery waste cleaning is much easier than with a staggered arrangement. Water enters the economizer at temperatures ranging from 220 to 320 deg. F., the latter being the normal operating temperature. The choice of the horizontal tube arrangement was dictated by the nature of the fuels. A vertical-tube arrangement would subject all tubes to acid attack at one end; by placing them horizontally, only a few tubes will be attacked and repairs to the economizer will normally be confined to them alone.

The eight burners are arranged in two rows of four each in the front wall. Each burner has an individual connection to a windbox which is supplied with unheated air at pressures up to 7 in. The burners are designed to handle liquid fuels, gas and pulverized coal simultaneously. Six of them can develop 300,000 lb. of steam per hr. with fuel oil. Burner tips are usually changed when shifting from fuel oil to the heavier waste fuels.

Forced- and induced-draft fans are driven by 650-lb. pressure turbines exhausting either to a 15-lb. main or a variable-pressure main at from 120 to 175 lb. The water to this and the other 650-lb. boiler is fed by three centrifugal pumps, two turbine driven and one motor driven. All are rated 700 g.p.m., 2,020 ft. head, 3,560 r.p.m.

Coal-Handling

Coal pulverizing equipment is of the unit type. Two 7.5-ton ball mills are so arranged that each mill can supply four burners. Each mill has its own feeder and exhauster. The coal stream is split four ways after leaving the exhauster. All pulverizing equipment is motor driven; feed regulators and safety attachments are electrically controlled.

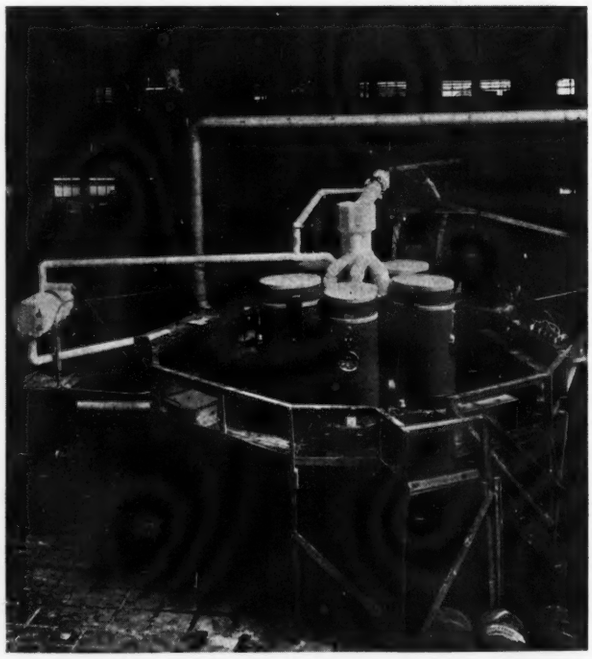
Coal is carried into the bunker of the boiler house by the same crane that was used to supply the chain-grate stokers of the low-pressure boilers. From the bunker it flows to automatic scales then to the mill feeders. Coal is stored in a concrete pit having a capacity of about 4,000 tons. The same pit has two bulkheads near one end, and in one of the compartments formed thereby are stored the bottom sediment from tanks, heavy sludges, carpenter-shop waste and similar refuse and petroleum coke which may be too oily for use in the pulverized coal mills. Into the other compartment the ashes from the furnace are transported hydraulically through about 200 ft. of sluiceway. The crane used for coal carries wastes to the colloidal fuel preparation plant and the ashes to a bin from which they are dropped into trucks or railroad cars. The entire system is exceedingly simple and reduces to a minimum the amount of equipment and labor required for handling fuel and ashes.

The new steam-generating unit is fully equipped with instruments and controls, including a smoke density recorder. Water level, draft and feedwater pressure are controlled automatically. No automatic control is used to regulate fuel feed because the unit normally operates at a fixed base load and because no control could be expected to operate satisfactorily with the many different fuels whose characteristics change continually.

The diagram illustrates the arrangement of the major items of equipment at the Central power station and shows quite clearly the simplicity of the plant. No effort has been spared to make it easy to operate and inexpensive to maintain. The engineers of the Standard Oil Co. appreciate the severe handicaps imposed by poor feedwater and poor fuels of high acid content and have learned that a few added dollars invested in more rugged equipment pay good dividends in lower maintenance charges, reduce the amount of spare capacity required and assure the refinery of an unfailing source of power and steam.

[There is no space to describe the unique feedwater treating system at Bayway. This may be the subject of a future article.—*Editor.*]

HOLYOKE'S HEATING HIVE



PROCEEDING according to one of the newest concepts in heating design, the Fred T. Ley Co., Springfield, Mass., is completing installation of a "hive" of more than 170 General Electric domestic oil furnaces at Mt. Holyoke College, South Hadley, Mass. Thermostatically controlled, only as many of the furnaces will be used at one time as will supply heating needs, thus allowing high-efficiency operation. The main heating plant will consist of a battery of 24 groups of five oil furnaces; the other 50 furnaces being installed where needed in isolated buildings. One of the 5-unit groups is shown here under test at Schenectady, with student engineers checking a heat run and making an analysis of flue gases.

BUGS

IN AIR CONTROL FOR PULVERIZED-COAL FIRES

By HARRY M. SPRING, JR.

A practical man's tips in handling furnaces burning pulverized fuel

A CORRECT percentage of excess air is important to obtain best operating results with pulverized coal. Proper air percentage can only be determined by trial under operating conditions. Calculations will give the approximate requirements necessary to select proper equipment, but maximum allowable furnace temperatures for the characteristics of the coal being burned will determine the practical limits of air flow. In general, excess air should be kept as close to zero as possible without causing the furnace temperature to hold the ash at its slagging or softening temperature as it comes in contact with refractory or heating surfaces. Refractory spalling will usually not take place until after this temperature has been exceeded.

Higher combustion ratings may be carried if secondary air is admitted so as to aid turbulence. It should be introduced at a number of points along the flame travel so the furnace will not be cooled excessively at one point. Secondary air should not cause the flame to thin out before reaching its maximum travel. It should, however, prevent scrubbing of the flame or direct impignment on refractory or heating surfaces.

Slagging of boiler tubes is a serious matter, and air flow should be controlled to prevent it. One plant operating at high rating experienced an unusual amount of slag on tubes. By the middle of the week the entire lower row of tubes was a solid mass of sticky slag, with the exception of a space about 5 ft. square that could be reached with a hook from a cleanout door. Unfortunately, plant engineers tried to carry as great a load as possible the rest of the week, with the furnace under positive pressure most of the time. As a result the brick arch burned out under the front header and collapsed. The bottom of the header, being covered with sludge on the inside, soon burned and bagged out in a section 48x5 in. The plant was shut down before an explosion resulted, but the damage was certainly a high cost to pay for slag.

Slag is best controlled by careful adjustment of air flow and frequent use of soot blowers when operating at high ratings. Slag removal when once started is difficult during operation, as the slag is usually a soft, sticky mass at high temperatures. Intelligent use of a small high-pressure stream of cold water often helps. It is directed either through inspection doors at the side of the setting or between the tubes.

Overheating of burners has caused difficulty in a few installations. This usually occurs on light loads when the velocity of the coal-air mixture through the burner is so low that it causes the fire to burn back into the burner. A little dust collecting on a rough spot on the inside surface of the burner becomes incandescent, and soon the entire burner is red hot. One plant had the misfortune to burn up five burner during the past two years before a change in plant supervision put a stop to the trouble.

Burners of the inclined venturi type were installed, two to each boiler. A butterfly damper was placed in each burner duct about 3 ft. from the burner. Each burner duct was provided with a 6-in. damper in its side which opened to the boiler room. Strict orders were given to use only one burner whenever a boiler was operated at less than 150 per cent rating. The damper on the side of the duct was then opened so the furnace draft would draw in air to cool the burner. No further difficulty has been experienced.

Methods of lighting pulverized coal burners are many. They include torches, oil and gas burners, both portable and permanently installed, some types electrically ignited. All these methods have their place and may be suitable in one or more types of furnaces. But above all things a pulverized-coal burner should never be lighted from the heat of the furnace. This is still done in some plants, but it is the most dangerous of all practices with this type of fuel. I have seen an operator light a burner in this manner, with a resulting furnace explosion that blew out part of the setting and narrowly missed causing serious injury.

Pulverization

Fineness of pulverization greatly influences efficient operation. Coarse particles fall to the furnace bottom, especially on light loads. Here they adhere to the ash, and as mixture with air is impossible they remain as unburned combustible. This is best prevented by systematic inspection and maintenance on the pulverizers. With the impact type of unit pulverizer the worn hammers or paddles should be on the first stages, the latter stages being kept in nearly perfect condition. As these wear slightly, have may be moved to the first stages. New hammers are then put in the last stages.

Fuel, primary air and secondary air are metered to each pulverized coal burner and are indicated on a three-element meter on the boiler-control board, where the operator has before him equipment for remote push-button control of each of three boilers

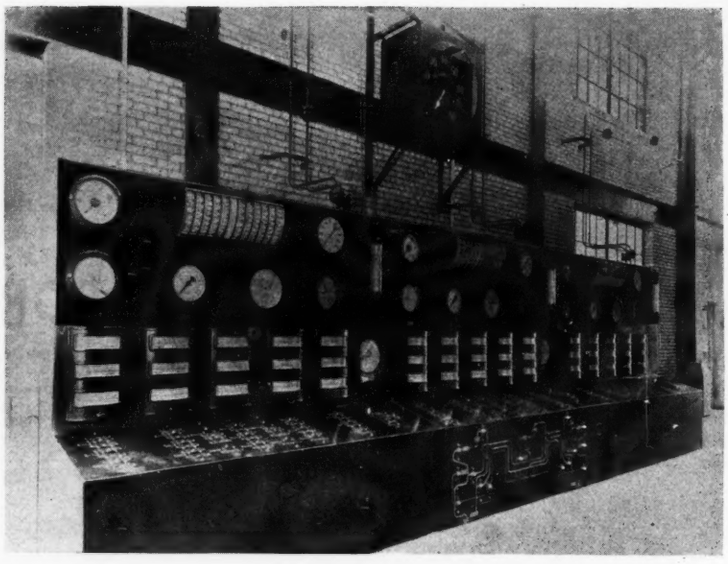


Fig. 1 — Three boilers, each with five pulverized coal burners, are controlled from this board

FUEL AND AIR METERED TO SOUTH AMBOY BOILERS

By F. A. ANNETT
Associate Editor

AT THE South Amboy plant of the Jersey Central Power & Light Co. both fuel and air are weighed automatically to each burner on the boilers. Each burner has its own pulverizer, and raw coal is weighed automatically to it in such a way that the weight is translated into rate of coal flow, pounds per hour. Primary air and secondary air to each burner are also weighed and their weights translated into rate of flow, pounds per hour. These three weights are indicated on a three-element meter for each burner on the boiler-control board. On this board the boiler operator has before him all the necessary meters and control devices for maintaining a proper combustion mixture in each burner to obtain the best efficiency. Provisions are also made on the board to control all functions of boiler operation necessary to maintain correct steam pressure at the turbine throttle.

The station contains two 25,000-kw. double-deck compound turbines operating at 1,250-lb. throttle pressure and 750-deg. F. temperature. Three 7,214-sq.ft. pulverized-coal fired boilers supply the steam. These boilers are equipped with superheaters, desuperheaters, air preheaters, economizers, gas reheaters and steam reheaters. The latter two reheat the steam on its way from the high- to low-pressure turbine elements. The furnaces have water walls and five pulverized-coal burners each.

Raw coal is stored in silos outside the plant. From each silo coal flows through a spout to a rotating-disk feeder which delivers it to a small weighing belt conveyor. This conveyor is enclosed and under the same pressure as is the mill feeder and is driven at a constant speed by a synchronous motor. It is mounted on an indicating dial scale and discharges to the pulverizer mill, Fig. 4. The scale is set at zero when the conveyor is empty so that coal weight being delivered to the mill at any instant is indicated by the scale. Since the feeder conveyor runs at a constant speed, the product of its speed and scale reading represents the rate at which coal is being fed to the mill, and this value is transmitted by a Selsyn motor to a meter on the boiler-control board.

All the combustion air for the five burners passes through the air heater and discharges into a common duct, Fig. 4, which is divided vertically and horizontally to provide a primary-air and secondary-air duct for each of the five burners. Each of these ducts has a metering orifice. On the air-heater side of these orifices the air pressure is maintained constant by an automatic pressure regulator that controls the speed of the forced-draft fans.

An air meter is connected across each of the orifices and is calibrated to indicate weight of air delivered. As the pressure is maintained constant at the orifice, absolute temperature only has to be compensated for in the meter, which is done by a special cam in the meter actuated by a temperature bulb in the air duct. Readings of the air meters, one for the primary and one for the secondary air to each burner, are transmitted to the boiler-control board.

On the boiler control board there is a three-element meter, Figs. 2 and 5, on which weight of coal in 1,000

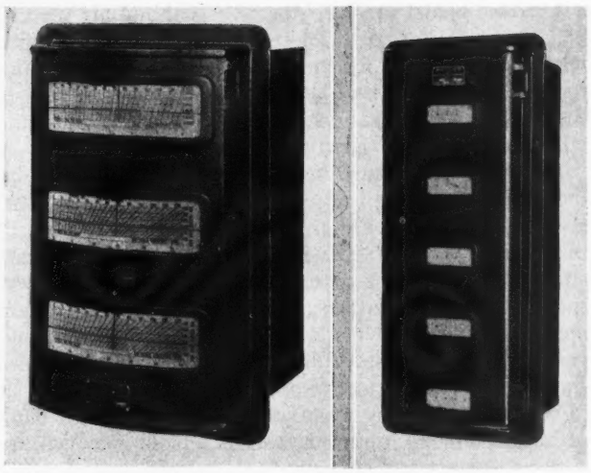


Fig. 2 (Top left)—Combination coal-and-air meters. Fig. 3 (Right)—Coal-weight integrator for five burners on one boiler

a movable horizontal line as on the coal meter. These lines are set at the desired percentage of excess air on each scale.

For example, in the figure, the excess air line is at about 18 per cent. By adjusting the air flow until the pointers rest over the intersections of the excess-air lines with the per cent burner rating lines, they will show, on the lower scales, the pounds of air being burned per hour. The dials on the three meters are so graduated that when their pointers show the same per cent of burner rating, fuel and air is being supplied to the burner at a rate that will produce the most efficient combustion. When this condition obtains, the three pointers will be approximately on the same vertical line.

The boiler-control board, Fig. 1, is divided into three sections, one for each of the three boilers. The equipment on one of these sections and their purposes are

Fig. 4 (Right) — Diagram of coal-weighing and air-metering equipment

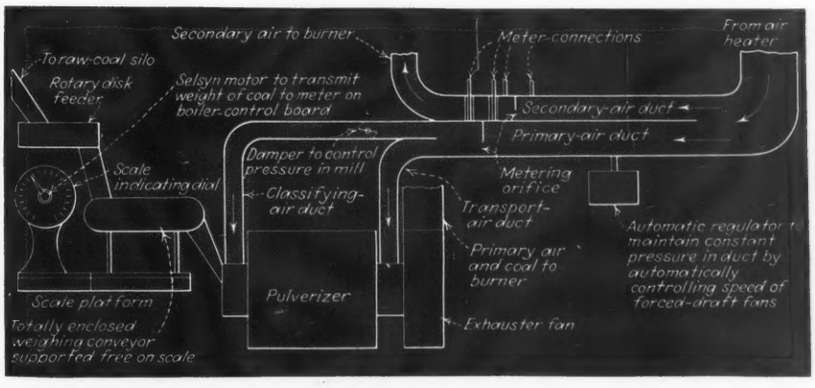

Secondary air to burner
Meter connections
From air heater
To raw-coal silo
Rotary disk feeder
Selsyn motor to transmit weight of coal to meter on boiler-control board
Secondary-air duct
Primary-air duct
Damper to control pressure in mill
Scale indicating dial
Classifying-air duct
Metering orifice
Transport-air duct
Primary air and coal to burner
Automatic regulator to maintain constant pressure in duct by automatically controlling speed of forced-draft fans
Scale platform
Pulverizer
Exhauster fan
Totally enclosed weighing conveyor supported free on scale

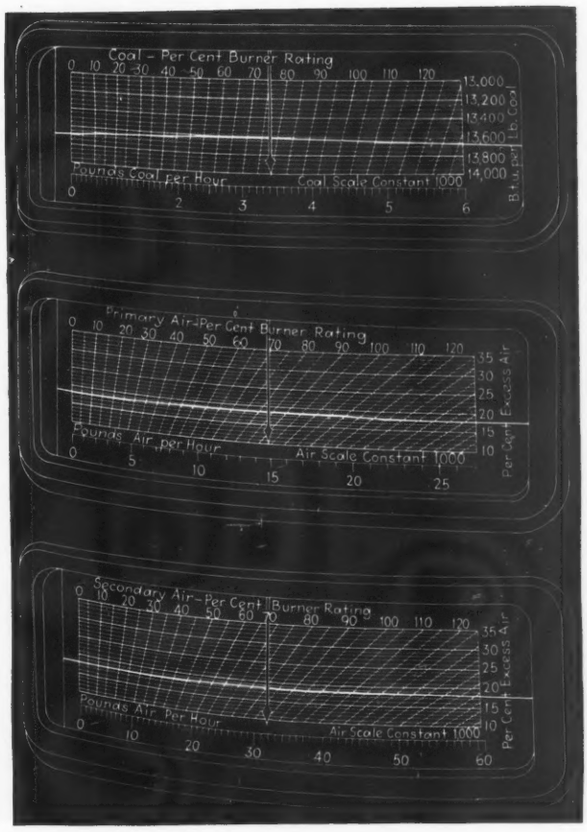
Fig. 5 (Right bottom)—Coal-and-air meter dials

lb. per hr. and weight of primary and of secondary air, in 1,000 lb. per hr., are indicated. On the meter the top scale is laid off in per cent of burner rating and the bottom scale in pounds of coal per hour of 14,000 B.t.u. per lb. Coal weights corresponding to per cent burner ratings are joined by vertical or nearly vertical lines. For example, on Fig. 5 at 77.5 per cent rating the burner will consume, per hour, about 3,350 lb. of 14,000-B.t.u. coal.

To compensate for coals of different heat values a vertical scale is provided on the right-hand end of the dial with an adjustable horizontal line. This line is moved to the grade of coal being burned. Its intersection with a given per cent burner rating line is the correct position for the meter pointer when the coal feed corresponds to that rating. For instance, in the figure, the adjustable horizontal line is on 13,675 B.t.u., and the pointer rests over the intersection of this line with the 77.5 per cent burner rating line. The meter indicates that the rate of 13,675-B.t.u. coal flow is about 3,430 lb. per hr. for 77.5 per cent burner rating, instead of 3,350 for 14,000-B.t.u. coal.

The middle meter, Fig. 5, is for primary air, the bottom one for secondary air. The top scales on these meters are graduated in percentage of burner rating as is the coal meter. The bottom scales give pounds of air per hour when operating the burners at these different percentages of rating and with 10 per cent excess air.

To compensate for different percentages of excess air, between 10 and 35, a vertical scale is provided on the right-hand end of the dials. These scales also have

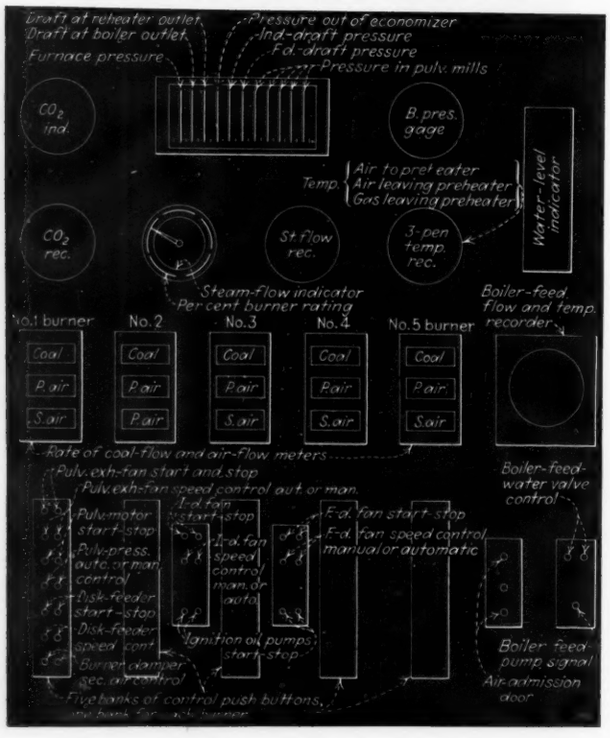

Coal - Per Cent Burner Rating
Pounds Coal per Hour
Coal Scale Constant 1000
B.t.u. per Lb. Coal
Primary Air-Per Cent Burner Rating
Pounds Air per Hour
Air Scale Constant 1000
Per Cent Excess Air
Secondary Air-Per Cent Burner Rating
Pounds Air per Hour
Air Scale Constant 1000
Per Cent Excess Air

shown in Fig. 6. In the center at the top of each section is an 11-point draft gage. Five of the pointers indicate the pressure in the five pulverizers on one boiler. Constant pressure is maintained within the pulverizer by push-button or automatic control of the damper in the classifying air line to the pulverizer, Fig. 4. When the speed of the exhauster fan is changed to increase or decrease the primary-air flow, the damper position in the classifying air line is adjusted to keep a constant pressure in the pulverizer. The indications of the other six pointers on the draft gage are given on the figure.

Of other meters on the board, mention should be made of the steam-flow indicator. This meter has two scales, the inner one graduated to show the pounds of steam being generated by the boiler. The other scale is made in five sections, one for each burner, and is graduated in per cent of burner rating up to 120. This meter not only shows the steam load but helps the operator to estimate the number of burners required.

For example, assume that the pointer is at 90 per cent on the scale of the third burner. It would be known that a burner capacity of 120+120+90=330 per cent, would be required. Normal operation is to operate all burners but one in service at as nearly 100 per cent load as possible and take the load swings on the partly loaded burner, which is not operated at less than 50 per cent. A burner capacity of 330 per cent would normally require four burners, three of which would be operated at around 90 per cent rating and the other at about 60 per cent rating. If the load increased it would first be picked up on the burner operating at low rating and transferred to the other burners if it remained. In these adjustments the operator is guided by the steam-flow indicator and steam pressure at the turbine throttle at which point effort is made to hold the pressure constant. Two turbine-throttle pressure gages are provided on the boiler-control board but are not shown in the figures.

Fig. 6—Layout of control board for one boiler



On this board are also the five coal-and-air meters, one for each burner. These are the operator's guide when adjusting the load on each burner, and maintaining the correct relation between fuel and air supply to the burners. The adjustments are made manually and when once set will remain practically constant.

On the control-board bench are push buttons and indicating lights for all adjustments that the boiler operator has to make. For each burner there is a bank of push buttons and indicating lights for starting and stopping the primary-air exhaust fan on the pulverizer; speed control of this fan; start and stop the pulverizer motor; automatic or manual control of pressure in pulverizer; start and stop disk feeder on the mill; speed control of disk feeder; and control of burner damper to regulate secondary air flow. In addition to this bank of buttons for each burner there is a bank in which are buttons to start and stop the forced-draft fans; buttons for speed control of these fans, either automatic or manual; and buttons to start and stop one of the ignition oil pumps. A similar bank of buttons is provided for the induced-draft fan and another ignition oil pump. On the front of the center bench of this board is a layout of the high-pressure steam piping and motor-operated valve locations with control buttons to open and close these valves.

From the foregoing it is seen that means have been provided to pre-measure the coal and air to each burner and to control these quantities manually from the boiler-control board, by remote-control switches and indicating lights. One operator can readily handle a 25,000-kw. boiler turbine unit from the boiler-room control board, including the adjustment of all combustion control and maintenance of steam pressure, water levels, etc. Temporarily, he can handle two of these units. The success of the equipment is shown by the high average monthly over-all boiler and furnace efficiency, 86 per cent, that is maintained.

Tests have shown the coal- and air-metering equipment to be very accurate. The coal weight to each burner is integrated on a five-unit meter, Fig. 3, for each boiler. The integrated records are usually within 0.5 per cent of the weight of coal weighed into the silos. On tests an accuracy of practically 100 per cent has been obtained. The metering equipment was supplied by the Bailey Meter Co., the automatic coal-weighing scale by the Toledo Scale Company and the special weighing conveyor was built by Kennedy-Van Saun Mfg. & Eng. Corp. from designs supplied by A. E. Burns and R. C. Roe, consulting engineers, 84 William St., New York City. Acknowledgment is also made to N. S. Burky, chief engineer, South Amboy plant, for his assistance in the preparation of this article.

Jacobus Tours Pacific—Dr. D. S. Jacobus, past president of the American Society of Mechanical Engineers, well-known advisory engineer with Babcock & Wilcox Company, and recently elected president of the American Welding Society, is on an engineering and vacation tour which will carry him as far as Hawaii. Passing through Boulder Dam on the way, he addressed sectional meetings of the American Welding Society in Los Angeles, San Francisco and Portland, and then continued to Hawaii, where he will speak before the Engineering Society of Hawaii.

His Welding Society address reviewed the history of the A.S.M.E. "Rules for Fusion Welding."

VARIABLE-SPEED DRIVES REDUCE CONDENSATE-PUMP OPERATING COST

By ARNOLD FRANK
Condenser Apparatus Division
Westinghouse Electric & Mfg. Co.

THE amount of water that a condensate pump must handle varies with the load on the unit being served by the condenser, but the pump must be selected to handle the condensate occurring at maximum load. Pressure against which the pump must operate also varies with load on the main unit and is composed of three elements:

1. Difference between atmospheric pressure and vacuum in the condenser.
2. Maximum vertical height to which the liquid must be raised above the pump level. This also includes any back-pressure such as may exist in surge tank or heater.
3. Piping friction, which also includes friction loss in passing through a condenser, heater, etc.

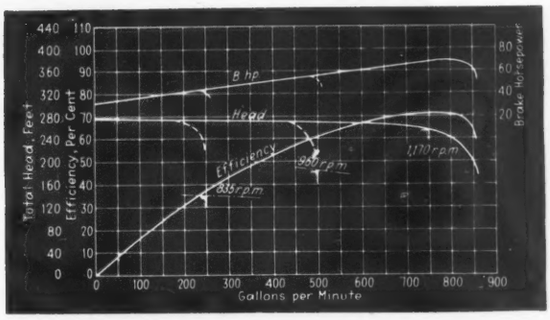
Items 1 and 2 are constant for all capacities, but Item 3 varies approximately as the square of pump capacity. Condensate pumps, however, frequently operate a large percentage of the time at less than normal capacity, due to reduced load on the turbine. The pump characteristics are generally such that, at a constant speed, efficiency is reduced as capacity decreases, and this makes it desirable to operate the pump at reduced speed.

In a plant where direct current or steam is available, variable-speed motors or turbines can be used to drive the pumps so that the speed can be adjusted to suit the head required. Pump horsepower is then proportionally reduced. As the driver efficiency within fairly wide limits does not vary greatly, the required horsepower is less than for the same pump capacity at constant speed.

Where only alternating current is available, adjustable speed can be obtained only by using multi-speed, or wound-rotor motors. Multi-speed motors contain a separate winding and pole combination for each speed, and although high in efficiency have very limited speed adjustments. The efficiency of wound-rotor motors with an external resistance decreases with the speed. Their advantage is that they afford practically the same speed adjustment as is possible with direct-current motors.

Loss in motor efficiency with an external resistance, at reduced speed, is generally more than counterbalanced by a gain in pump efficiency. For example, assume pump to deliver 750 g.p.m. at maximum steam flow to the condenser. The pump will also operate at 500 and 250 g.p.m. Head on the pump is composed of 30 ft. vacuum, 94 ft. static and 132 ft. friction at 750 g.p.m. This makes the friction head at 500 and 250 g.p.m. equal to 58.8 and 14.7 ft. respectively. The pump is therefore to deliver 750 g.p.m. at 256 ft. head, 500 g.p.m. at 182.8 ft. and 250 g.p.m. at 138.7 ft. total head.

A 5-in., 2-stage pump is chosen with the characteristics of Fig. 1. The three conditions of operation, at best operating speed, are also shown on the curves. For constant speed of 1,170 r.p.m. the results would be:



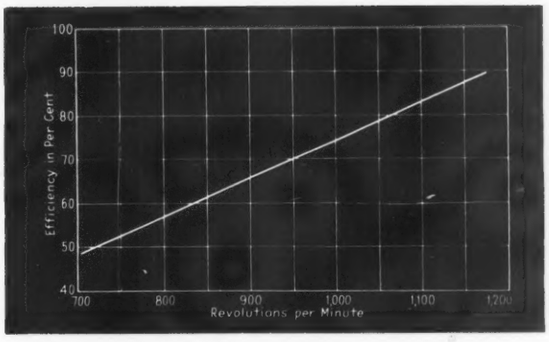


Fig. 1 (Top)—Characteristic curves of a 5-in., 2-stage, 1,170-r.p.m. pump. Fig. 2—Speed-efficiency curve of a wound-rotor induction motor

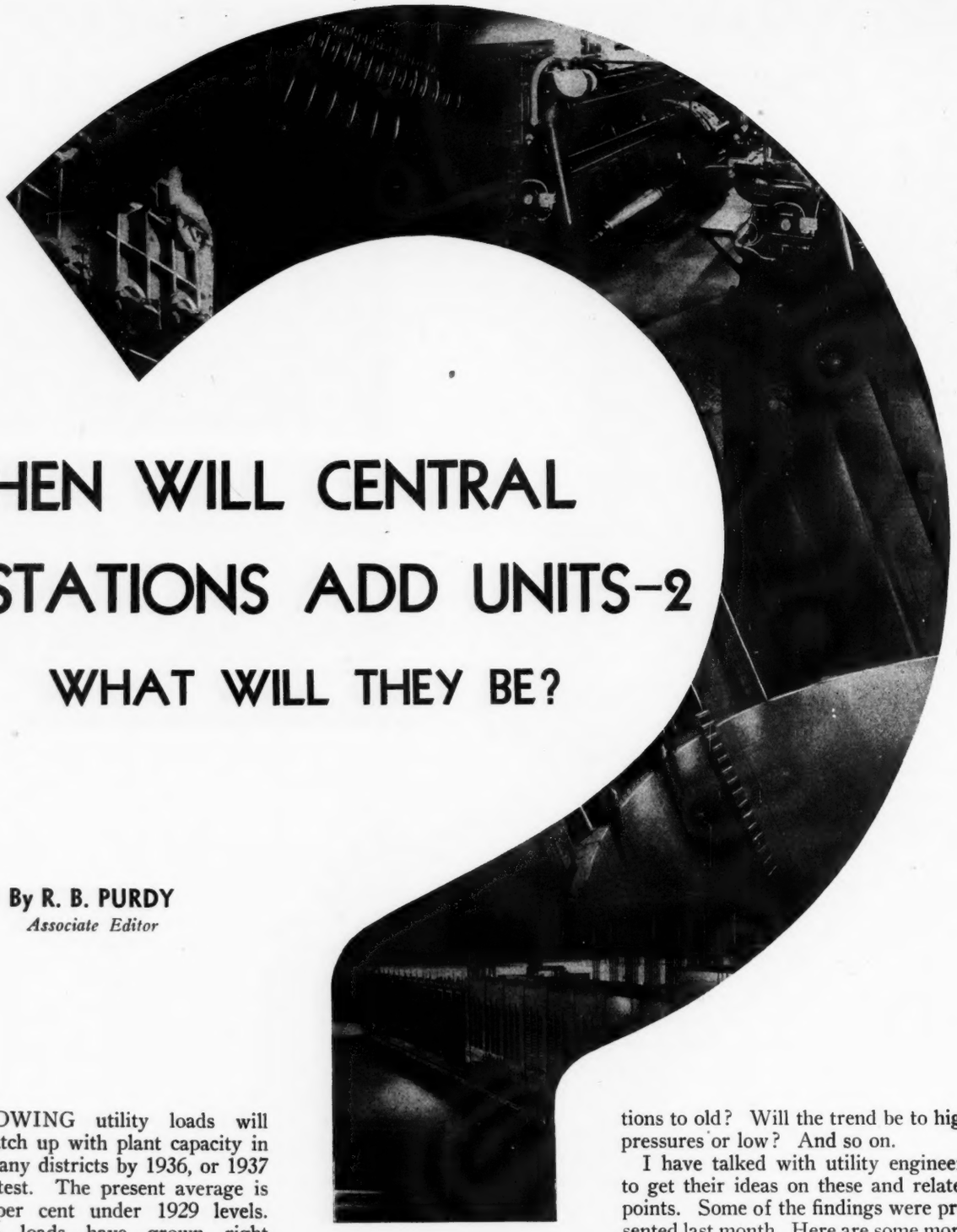
G.P.M.	Head in Ft.	Pump Hp.	Motor Eff. %	Motor Hp. Input	Unit Eff. %
750.....	256	67.8	89	76.2	63.7
500.....	182.8	52.2	88	59.3	39.0
250.....	138.7	41.0	87	47.3	18.5

Using a wound-rotor variable-speed motor having the speed-efficiency characteristic of Fig. 2, and accepting the most suitable speed, the following results are obtained:

G.P.M.	Head in Ft.	R.P.M.	Pump Hp.	Motor Eff. %	Motor Hp. Input	Unit Eff. %
750.....	256	1,170	67.8	89	76.2	63.7
500.....	182.8	960	34.2	71	48.2	47.8
250.....	138.7	835	17.5	60	29.2	30

Comparison of the two tables shows that if we assume that over a period of time the pump is used equally at all three conditions, on the basis of 24 hr. per day service there would be a saving of 235 hp.-hr. or 175 kw.-hr. per day.

The price of a standard 75-hp., 6-pole, 2,200-volt squirrel-cage motor and control is $730, while that of a similar wound-rotor motor with external-resistance speed control is $1,050, a difference of $320. On the basis of 175 kw.-hr. per day, the saving in power at the rate of 1.2c. per kw.-hr. would be $2.10 per day. The additional cost of the variable-speed motor would be paid for in $320 \div 2.10 = 152$ days, or less than 6 mo. After this there would be a saving of approximately $765 per year.



WHEN WILL CENTRAL STATIONS ADD UNITS—2

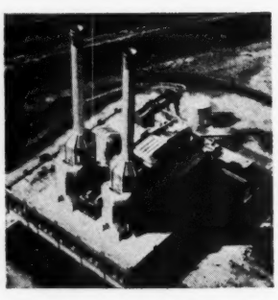
WHAT WILL THEY BE?

By R. B. PURDY
Associate Editor

GROWING utility loads will catch up with plant capacity in many districts by 1936, or 1937 at the latest. The present average is only 5 per cent under 1929 levels. Domestic loads have grown right through the depression and have largely offset the slump in industrial load.

It takes time to plan additional capacity, place orders, build and install equipment. Plans should be started at once for a job that must be in operation in 1936. Depleted engineering staffs make the problem more difficult. What to do?

Clearly the first step is to study the general situation. What form will new capacity take—new stations or additions to old? Will the trend be to high pressures or low? And so on.



I have talked with utility engineers to get their ideas on these and related points. Some of the findings were presented last month. Here are some more.

In the opinion of most central station engineers with whom I have talked, few new plants will be built within the next three or four years. The first capacity added will generally be in existing stations, either at the same pressure and temperature in the case of recently built plants, or with increased pressure and temperature for additions made to older stations. The amount of capacity that can be added in plant additions is, in general, relatively small.

New plants will have to be built—how soon, of course, depends upon the rapidity of industrial recovery.

Much can be said in favor of capacity added by modernization of existing old plants. By increasing steam temperatures to 850 to 900 deg. and pressure as high as possible without the necessity of reheating to avoid trouble from moisture in the low-pressure turbine blading, it is possible to install new turbines of at least 50 per cent greater capacity in the same building space and using the old condensers and auxiliaries. Although this requires new boilers, turbines, piping and feed pumps, the cost per kilowatt is not high and the result is practically a new plant of high efficiency and about 50 per cent greater capacity. Costs per kilowatt are low because land, building, coal-handling equipment, condensers, auxiliaries and electrical work already exist and require but little investment to adapt them to the new conditions. When changes are made, the building must be altered or the equipment adapted to the existing structure. This usually requires a compromise with the most desirable arrangement. In addition, certain useful equipment must be retired and written off of the company's capital accounts.

A modernization program as extensive as this is not, in general, ever justified by savings alone, but when the additional capacity obtained is considered the project may become very attractive and worth much study.

Connors Creek Replaces Old Turbines

Such a program is now in progress in the Connors Creek plant of Detroit Edison Co. the first units of which were placed in operation in 1915 at 225 lb. pressure and 180 deg. superheat. The three original 20,000-kw. units are now being replaced by three 30,000-kw. turbines, and new boilers to operate at 600 lb. pressure and 825 deg. are being installed.

A capacity increase of about the same per cent can be secured by adding a high-pressure "top" to an existing plant. This means the installation of new boilers of capacity equal to the old boilers and new non-condensing turbines of sufficient size to pass enough steam to operate the old low-pressure turbines at full load.

Although this usually requires an extension to the power plant building, it would probably cost less per kilowatt of added capcaity than complete modernization, since the new turbines represent the entire increase in plant capacity. The lower cost is offset to some extent by the continued operation of the lower efficiency low-pressure turbines. An 8 or 10 per cent lower efficiency ratio of the old turbines and the lower tip speed of their low-pressure blades permits going to higher pressures without the necessity of reheat for any given safe initial steam temperature. With this difference in efficiency, approximately the same moisture conditions would exist in the low-pressure stages with a "top" of 1,250 lb. and 850 deg. as in a new installation of 650 lb. and 850 deg.

Plants Add "Tops"

Several plants have added "tops" in the past few years, notably the Burlington Plant of Public Service Electric & Gas Corp. and the Honolulu plant of Hawaiian Electric Co. Both of these tops operate at 650 lb. pressure and 850 deg. F. By this means the heat rate at Burlington was reduced to 14,460 B.t.u. per kw.

Such new plants as may be built, it is felt, will follow closely the trend shown by the few new plants that have been designed and built during the depression. A desire for dollar economy will make for simple plants with less complex heat balance. The proved high reliability of both boiler and turbine, as shown by reports to the A.S.M.E. and the Edison Institute, together with interconnection of systems, will further plants built on the unit principle of one boiler and one turbine.

1,250 lb. Without Reheat

Engineering opinion indicates that pressure and temperatures will be high. In general the pressure selected will be as high as steam temperature will permit without the necessity of installing expensive reheat equipment. Some engineers predict plants using 1,250 lb. pressure with 900-deg. steam operating without reheat, but more plants will be designed for about 700 lb. pressure at the boiler and 850 deg. than for the more severe steam conditions.

Low-pressure turbine blades with Stellite shields have been found to resist erosion due to the amount of moisture usually present in the turbine exhaust. Shielded turbine blading and lower tip speeds may permit higher moisture in the turbine exhaust than now used without excessive erosion. This, of course, will permit higher initial pressures for a given steam temperature.

A few central station engineers see merit in the reheat cycle provided the methods of reheating can be simplified. Using high heat content liquids of high boiling point such as the diphenyl compounds and putting the reheaters in the cross-over connection between high- and low-pressure cylinders are some of the simplifications suggested.

It is not clear yet whether there will be a trend toward the use of contact-type bleeder heaters instead of the usual surface-type closed heater. The contact-type heater decreases terminal temperature difference and eliminates the problem of handling heater drips, but may not be so flexible in operation on sudden changes of load.

Increased use of the diesel engine in municipal plants and their generally improved reliability has caused many central station engineers to show interest in this type of prime mover—not that there is any likelihood that the diesel engine will be used in any of the larger central stations as main units. They are, however, being considered for certain auxiliary drives, as emergency units and for use in small plants in outlying districts where a plant of small capacity would help to hold up transmission voltage.

TO SUM UP

The central station engineers I talked with left the following impressions which summarize this article and that in POWER for September:

1. By the winter of 1937 electric utilities will have added considerable generating capacity to their systems.

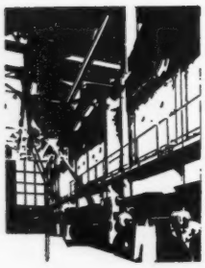
2. Plans for new capacity must be made and orders placed as soon as possible if the new units are to be ready in time.

3. Because of depleted engineering organizations, capacity added will be of standard design.

4. Every effort will be made to keep the cost per kilowatt as low as possible, because capital will not be easy to obtain.

5. Few new plants will be built, most of the capacity being additions to existing stations.

6. Temperatures will be in the 825 to 900 deg. range with steam pressures as high as possible without reheat.



CAULKING TO PREVENT CAUSTIC EMBRITTLEMENT

By E. F. ECKEL
Elgin Softener Company

CAUSTIC embrittlement is the result of high concentration of caustic soda in capillary spaces of boiler drums. Parts under comparatively high stress are first affected. Thus rivets, because of the change of direction of the grain of the metal where the head joins the shank and because of possible cooling stresses set up during driving, are particularly vulnerable.

A second common point where embrittlement becomes evident is at the ligaments between rivet holes in butt straps or in the ligaments between rivets in the drum head. Sometimes microscopic cracks occur between the outer row of rivets and the edge of the butt straps or head plates. It is apparent, therefore, that localized stress has a bearing upon embrittlement.

In any boiler seam or joint, it is entirely probable that the stress is first taken up by some localized section of the seam or by a few rivets and is then distributed throughout the seam and over all of the rivets. So long as there is a slight ductility in the plate and in the rivets this distribution of the entire stress may easily take place. Upon embrittlement of the rivets or the plate, however, a few rivets that receive the first stress may be so brittle that their first action is to crack.

Some boilers are caulked only on the inside, others only on the outside, others both inside and outside. I am doubtful that any of these three expedients are effective as a guard against embrittlement.

Let us first take the case of a boiler caulked only on the inside. The idea of this is that, as the seam is caulked only on the inside and apparently does not leak, it is impossible for caustic soda to concentrate under the joint. When it is remembered that boiler seams are generally hidden from view and in many cases covered by brick-work and that small leakage may occur for years without being observed and, further, that if leakage does occur and is observed it is difficult to determine the exact point of inside leakage, it is obvious that inside caulking alone is not sufficient.

Outside caulking alone, of course, offers no protection against the concentration of caustic soda in the boiler seams. It is believed that this type of caulking is generally being abandoned.

With reference to both inside and outside caulking. This type of caulking, in itself, may be even worse than only inside caulking, because leakage through the inside seams may traverse the entire length of the drum and be apparent at some distant part of the drum where the outside caulking was not tight. The fact that embrittlement has occured where boilers were caulked both inside and outside, is ample evidence that this precaution alone is not sufficient.

There is, however, a great advantage to be gained by both inside and outside caulking. It is apparent that this advantage has been overlooked by boiler manufacturers.

When both inside and outside caulking is used it is entirely possible to install small tell-tale pressure connections so that high liquid pressure may be injected between the seams themselves. In this manner any inside leaks and outside leaks may be detected readily and their exact location observed. Further these tell-tale connections may be arranged so that any leakage through the inside caulking may become immediately apparent to boiler tenders.

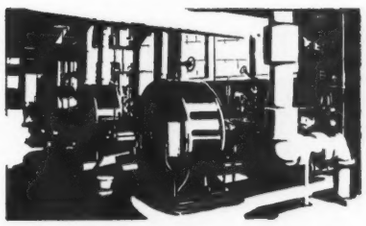
The writer has observed, in several instances, leakage around the boiler head, through the outside caulking, and upon thorough examination determined that this leakage was coming through the inside caulking at an entirely different part of the drum. It was only by applying pressure back of the seam itself that the exact location of this inside leakage could be determined.

The point of this article is that both inside and outside caulking, with properly located tell-tale pipes for leakage, is a most efficient way of detecting leakage.

It is a well-known fact that boilers which have become embrittled or are subject to embrittlement, are usually entirely free from scale. This, of course is due to the high caustic alkalinity of the water which effectively inhibits the formation of scale. It is also true that boilers in which leakage is habitual are usually free from scale and usually because of this high alkalinity. The formation of scale in the boiler is of course not desirable, neither is high alkalinity nor leakage, so that the entire problem really becomes one of a chemical nature in which both scale and high caustic alkalinity are to be considered. The most effective measure seems to be the maintenance of the correct amount of sulphate over the alkalinity and at the same time the maintenance of the correct low alkalinity to prevent scale formation.

It is my opinion that outside caulking alone should not be used, that inside caulking alone does not prevent the seepage of boiler water under the seams, as this seepage may go on for months without being detected, and that both inside and outside caulking, with the proper tell-tale pipes, is most efficient. The problem of caulking, of course, has little to do with the embrittlement of rivets. The matter of embrittlement is one to be solved by the chemical engineer and the seamless boiler drum.

PURCHASING AGENTS AND PACKINGS



A KICK By ENGINEER COOKE

MISUNDERSTANDINGS between purchasing agents and power plant engineers frequently occur over the question of packings on hand when inventory is taken. Naturally, the chief engineer can see no signs of lack of economy in his having a 12½-ft. box of ⅛- to 2-in. spiral packings on hand to fill space between rods and stuffing box walls, or reels of 1/16-, ⅛-, ¼-, 5/16-, ⅜-, 7/16-, and ½-in. graphite-treated asbestos packing for valve stems.

A complete stock of packings has always been my weakness, due no doubt to my propensity for being in charge of plants under construction in out-of-the-way places. I even like to have ⅝- and ¾-in. gage-glass packing rings and a few ½-in. for the donkey boiler water columns. I have seen many engineers out of one or more of the ¼-, ⅜-, ½-, ¾-, 1-, 1½-in. and upwards of composition valve disks, with round and oval center holes. I contend that the most expensive valve-seat renewal is cheaper than the smallest steam, oil or chemical leak through a leaky valve, not to speak of danger and operating annoyance, and that a stock of valve disks on hand is the cheapest insurance premium.

Whether the fancy of the chief in boiler manhole and handhole gaskets leans toward those reinforced with fine brass wire, or to tube gaskets, the fact remains that you cannot afford to operate a battery of boilers with a short stock of gaskets in the tool locker. Even a power plant engineer has his unlucky days, and I know of no more sickening feeling than to have a boiler gasket blow, and to be out of material for repacking.

With all due respect to executives, it does at times become difficult for the office staff to realize just what trouble may come to a chief on a single operating shift when it comes to packing, especially on a busy day when the plant is sadly overloaded.

I learned my lesson when worn-out hydraulic packing rings, doing 6,000 lb. per sq.in. service, fluted and destroyed a set of plunger rods, all to save $1.75 packing stock. I have seen too much brine wasted for the sake of fibre flax packing, and too much hot syrup and oil wasted to save a little hard black packing, to be deeply concerned with packing economy arguments. I would rather buy my own out of my salary than to go without—which in all truth I have done.

In theory an engineer should not have old pumps with rods out of alignment, but if they are in use in the plant, possibly through circumstances over which the chief may have no control, then they must be operated, and round-cornered packing must be in stock.

I put up my most recent argument for a softer packing for engine governors when a Gardiner governor ball shot past my ear on its way up through the roof. Any power plant engineer may appear to be somewhat of a crank, but when his experiences include scores of incidents such as this he knows what he wants.

If there is a mechanical engineer on earth who can outline a better investment around a steam or diesel plant than a good selection of sheet packings I'd like to hear of it. Yet in far too many plants the chief is allowed one sheet of packing, as if there was a general-purpose sheet packing to suit the entire requirements of the power world. It is reasonable that the chief should want sheet packing with an asbestos base for steam hose gaskets, steam chests, gasoline engine igniters, manifold gaskets and the like. Just as he must have oil-proof sheet packing for heavy oils, joints and cylinder heads where gaskets are likely to become oil saturated and also for the gear cases of machinery transmission. Sheets of 1/32-, 1/16-, 3/16-, and ¼-in. packing for high-pressure and superheated steam joints, to serve also for air compressors, ammonia and acid packings, also wire-inserted sheet packing for pipe flanges, gaskets for steam joints and packing against alkalies, syrups and hot water—all these are standard operating supplies.

It is almost a mechanical engineering calamity that too few of what we might term our office staff know that oil will rapidly disintegrate rubber. They will insist in many instances in confining the chief to one packing of this nature. This is by no means idle speculation. In an explosive plant, mark you, I had a P.A. who insisted on keeping to such a rubber packing, in spite of the fact that a huge plunger descended into a chamber coated with thick cylinder oil. Consequently every shift I had to take four 40-ton jacks, jack out this massive plunger and religiously replace a rubber gasket that would go out again the next shift. A field man of the rubber company had to support my demand for leather packings before that P.A. would recognize the truth.

TEST SOFTENER OPERATION BY THIS SHORT CUT

By H. M. RIVERS
Kansas State College

WATER softener operation is controlled by chemical tests of the treated water. Where raw-water composition changes rapidly, chemical dosage won't stay put, and the routine chemical tests of treated water must be made at shorter intervals. This runs up the cost of operation.

Many plants could reduce this expense by using a simple silver nitrate solution test in place of some of the more elaborate and expensive titrations with standard solutions. The silver nitrate test is no cure-all. It is not offered as a substitute for the standard tests, but rather as a way to reduce the number of these tests.

Water treatment is a technical process requiring the services of a specially trained attendant. Moreover, the standard acid and soap solutions are expensive, and the time consumed in testing the water is considerable. The silver nitrate test, on the other hand, is cheap, simple and rapid. Its accuracy is assured by the very chemical principle upon which it is based.

Here is the test: To a 50-cc. sample of treated water (about an inch of water in a 150-cc. Erlenmeyer flask) add ten drops of a 10 per cent silver nitrate solution. If the sample becomes milky upon shaking, the water is being under-treated. A light canary yellow color indicates a causticity of about 30 p.p.m. (as calcium carbonate) —the value generally corresponding to good operation of chemical softeners.

If, however, the silver nitrate produces an intense yellow color tending toward light brown, the water is over-treated. If this brown color deepens upon addition of more silver nitrate solution, the water is being excessively over-treated.

In the accompanying table are the approximate colorations produced by silver nitrate solution in water samples of various hydroxyl concentrations.

When the nitrate solution is added to the sample of treated water, all but very little of its hydroxyl content is immediately thrown down as a reddish yellow precipitate. The amount of precipitation, hence the intensity of color, depends solely on the amount of causticity in the water. For that reason accurate measurements (of sample or silver nitrate) are entirely unnecessary.

Initial and "batch" chemical dosages are generally calculated according to the composition of the raw water as indicated by the water analysis. When once the batch is made up, later adjustments of chemical feed to compensate for temporary disturbances are usually made by "thumb screw" or "wing nut" devices on the mechanical chemical feed. Naturally, such devices can do no more than increase or decrease the rate at which a solution of fixed lime-soda ash composition is fed, except in those larger installations wherein lime and soda ash solutions are fed simultaneously from separate tanks. And so, after a batch has been prepared, the operator's primary concern is whether or not this chemical mixture is being properly fed into the raw water. To check for over- or under-treatment, he runs tests on the treated water, making changes in the rate of chemical feed as suggested by the results of these tests. Right here the silver nitrate test finds its greatest application.

1. Add about ten drops of 10 per cent silver nitrate solution to about 50 cc. of treated water.

2. Shake and note color. Read hydroxyl concentration from following table; 30 p.p.m. is about right for most waters. This corresponds to reddish yellow or light brown. Darker color indicates over-treatment, lighter color under-treatment

Color	Hydroxyl Concentration p.p.m.	
Milky or translucent	0— 5	Too little
Light yellow tint	5—10	
Pale yellow	10—15	
Light yellow	15—20	
Strong yellow	20—25	
Yellow, reddish tint	25—30	Right
Light brown	30—40	
Reddish brown	40—50	Too much
Darker shades	50—on	

Working day after day with any softening unit, the intelligent operator will gradually learn how to recognize and correct for changes in the normal operation of his plant, often with no more than a hint as to when and how much to alter his chemical feed. Experience will soon teach him that satisfactory operation of his softener can be maintained only if the hydroxyl concentration of the treated water is kept at about a certain point; this critical causticity will produce a characteristic color with the silver nitrate solution, and the operator will come to associate this particular color with good treatment of the water.

Small deviations in coloration one way or another from the desired intensity indicate over-treatment or under-treatment, but generally slight enough to be correcetd by adjusting the rate of chemical feed. However, if the test gives a color considerably different from that normally expected, it indicates that something has disturbed the "balance" of the chemical reaction within the softener. It will then be necessary to make the more careful standard chemical tests of the raw and treated waters in order to learn the exact cause and the steps needed to correct the treatment.

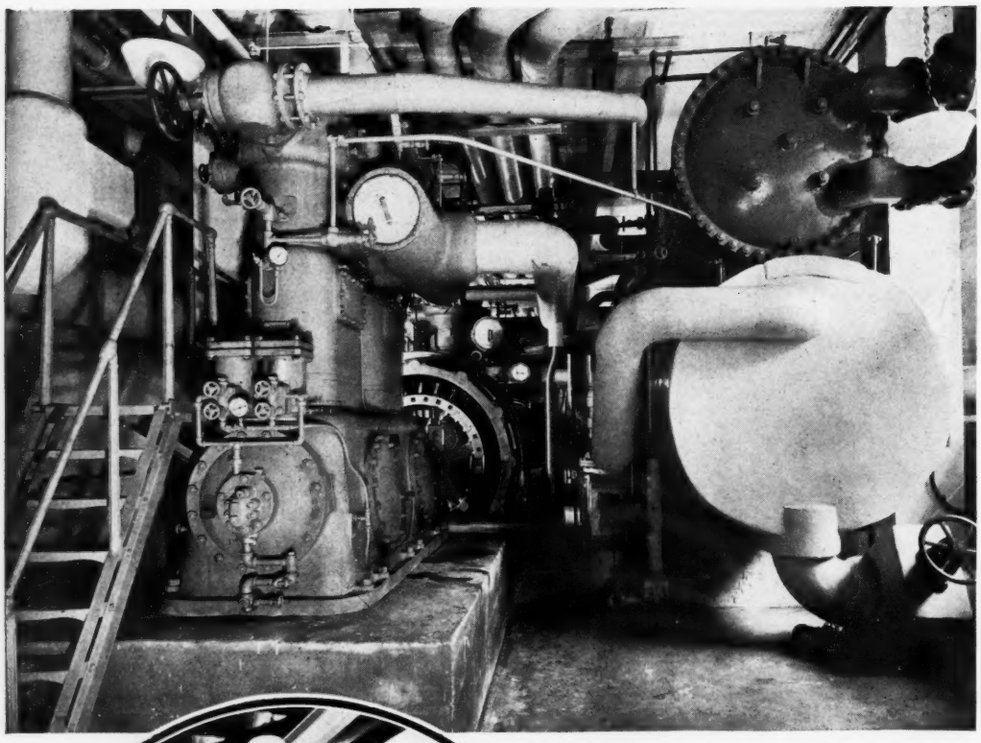
Natural water supplies and operating conditions vary greatly with different softening plants. The utility of any elementary test of this nature depends on such conditions and on the "human element" involved in its application. Hard and fast rules of procedure may cause trouble. For best results make the test first in the manner indicated, but do not consider it final. Find out by actual trial, under your own conditions, what color corresponds to correct treatment.

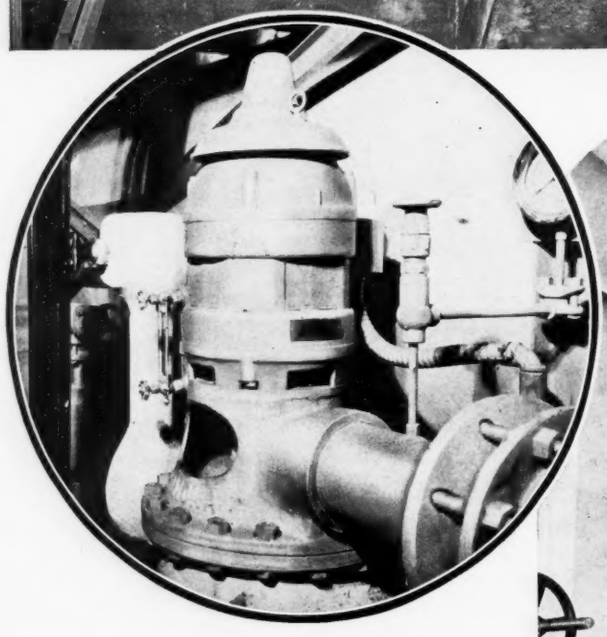
Waters high in chlorides, for instance, will produce heavy white precipitates which will veil the coloration caused by the causticity. The silver chloride precipitate may even be so dense as to make the test worthless. However, normal waters reasonably low in chloride concentration will be found well adapted to the nitrate test.

Childishly simple though the test may be, it is an accurate indication of over-treatment or under-treatment, and this is often sufficient to let the operator know whether to increase or decrease the rate of chemical feed. The test has been used with remarkable success in one plant where raw-water composition, exhaust-steam pressure, and rate of flow of water through the softener vary greatly from hour to hour. And it could undoubtedly be applied advantageously to softeners of the single-feed type which are used to treat river water or spring water in which the hardness is subject to frequent and sudden changes.

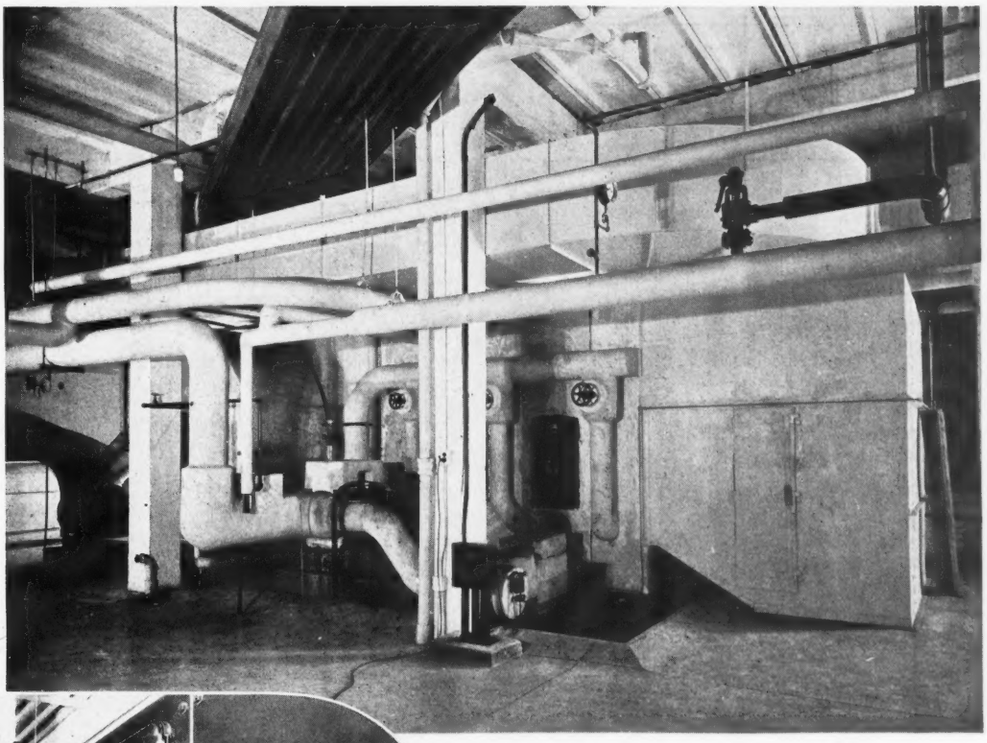
Justice AIR-CONDITIONED

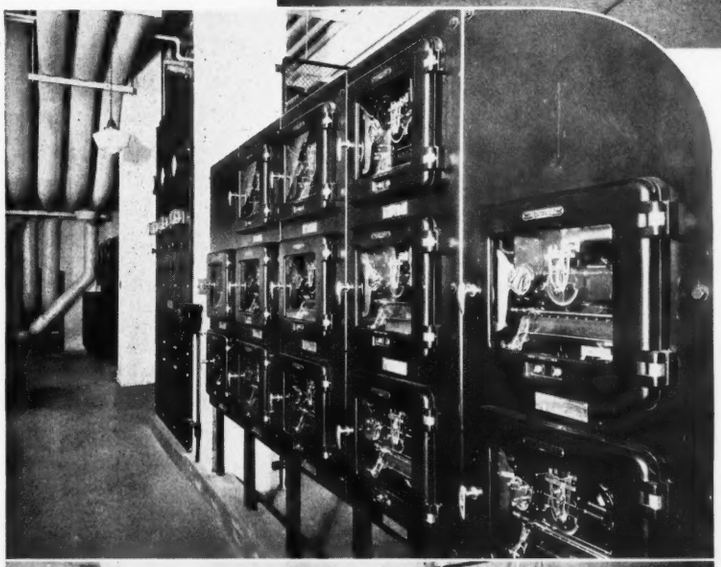
1950 tons of Freon refrigeration air-condition all occupied space in the new 8-story, 525 x 416-ft. Department of Justice Building, Washington, D. C. Liquid refrigerant is pumped to the shell-and-tube type water coolers, where it is sprayed over the water tubes. Refrigerated water is circulated to the air washers, where it washes and conditions the air. Conditioned air is supplied to each room vertically through nozzle-type window units. Special controls permit quantity of air flow to be adjusted to meet individual requirements. Louvers in doors allow return air to flow into the corridors from which it is exhausted and returned to the air washers. Fans, air washers, humidifier pumps and heaters are on the 8th floor, this location greatly simplifying ductwork. The system is designed to maintain inside conditions at 80 deg. dry bulb and 50 percent relative humidity. Total connected motor load is 3,000 hp. Compressors are duplex, vertical, single-acting units driven at 257 r.p.m. by synchronous motors. Condensers have 21,000 sq.ft. of effective surface, handle 5,800 g.p.m. of water at 85 deg., the coolers have 18,000 sq.ft., and cool 6,300 g.p.m. of water to 49 deg. F. Condenser shells are 53 in. in diameter, cooler shells 55, and both have 20-ft. tubes. (Detail photographs on following page).

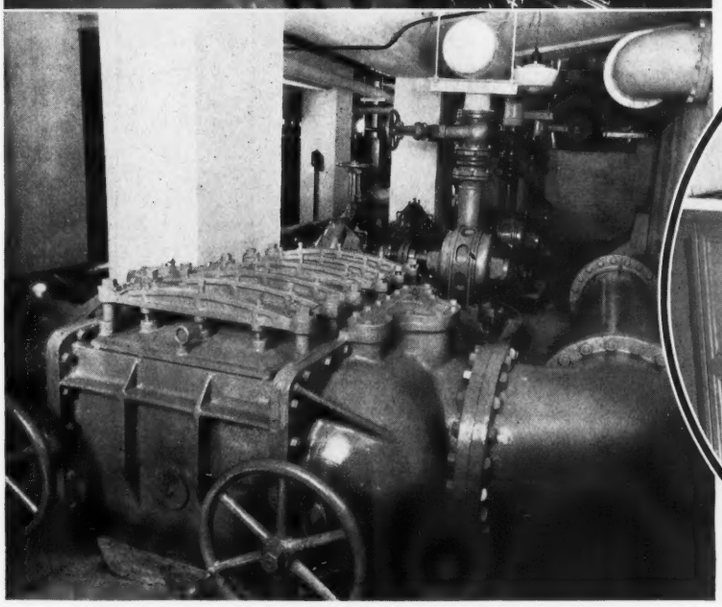


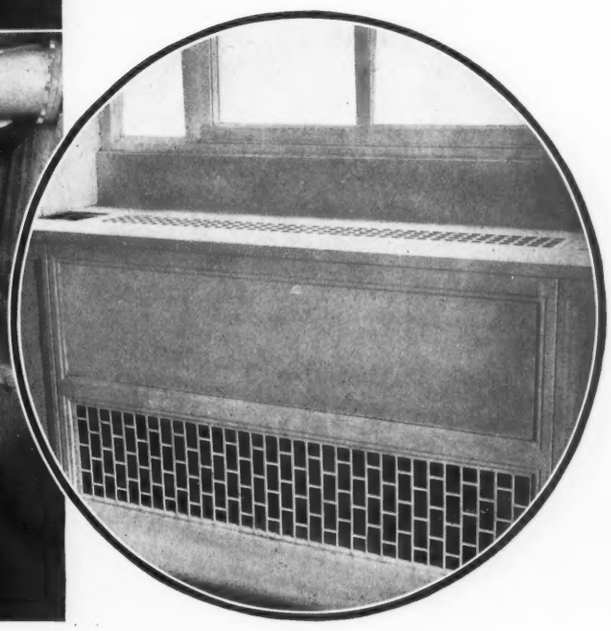


Top—Each of the three 8-cyl., 15x11¾-in., 650-ton Freon compressors is served by its own multi-pass shell-and-tube condenser and water cooler shown to the right of the compressor. Above—Liquid refrigerant pumps deliver Freon to spray heads in the water coolers. Right—Three 2,000-g.p.m. pumps, driven by 125-hp. motors, circulate chilled water at 1,750 r.p.m. and 175-ft. head through a 14-in. header to nine air washers.



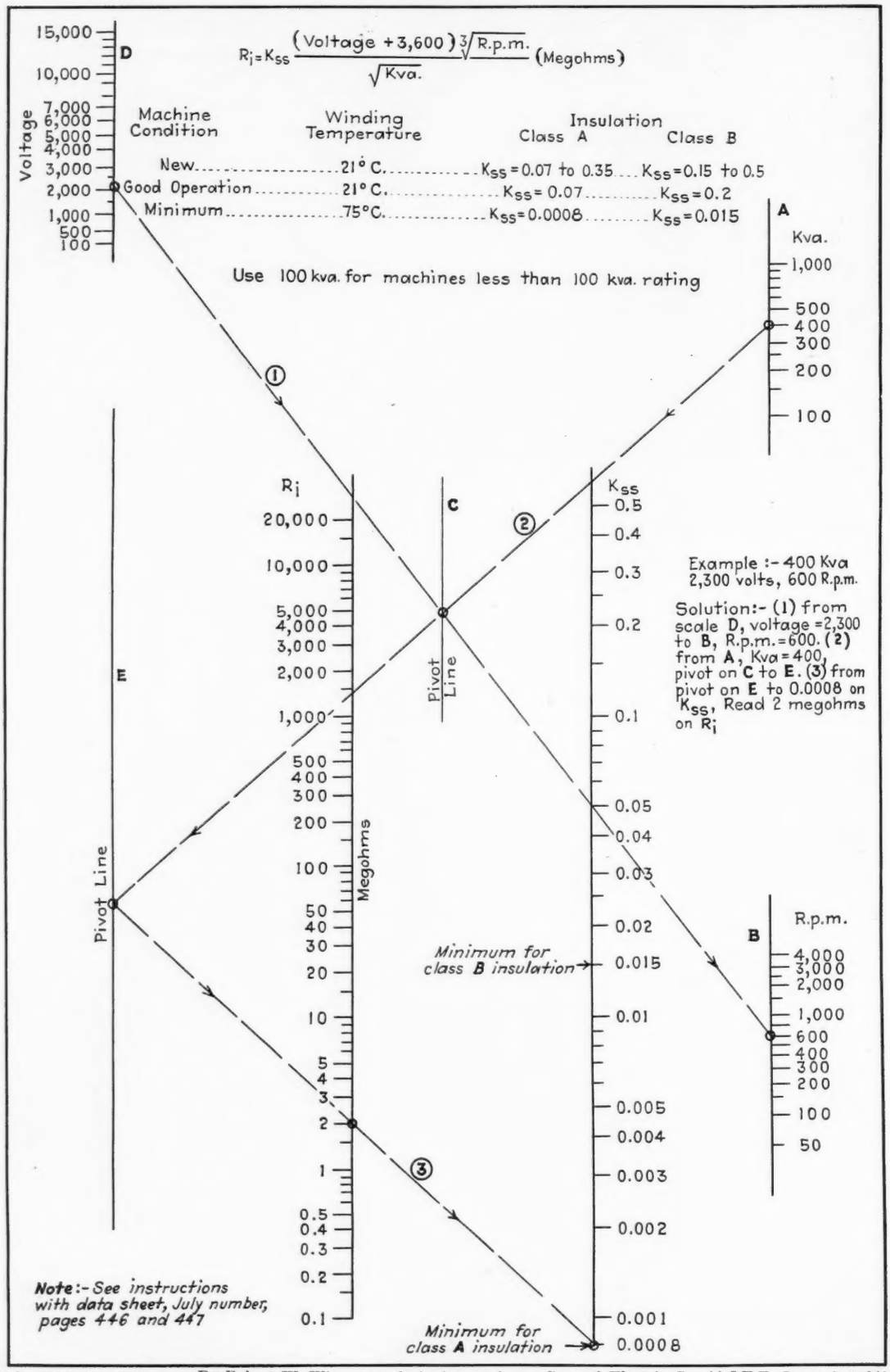






Top—Nine air washer units on the 8th floor supply separate systems. Left—Temperatures are recorded by electric resistance-type thermometers. Bottom left—Water for condensing refrigerant is taken through a 20-in. duplex strainer from the Potomac River Basin. Bottom right—Conditioned air is supplied through 1,526 window units, each individually adjustable by knob and sylphon bellows which vary cold-air nozzle opening.

Insulation Resistance of Armature Winding for Synchronous Machines Below 1000 KVA.


$R_i = K_{ss} \frac{(\text{Voltage} + 3{,}600)\sqrt[3]{\text{R.p.m.}}}{\sqrt{\text{Kva.}}}$ (Megohms)
Machine Condition
Winding Temperature
Insulation Class A
Insulation Class B
New ... 21° C. ... K_{ss} = 0.07 to 0.35 ... K_{ss} = 0.15 to 0.5
Good Operation ... 21° C. ... K_{ss} = 0.07 ... K_{ss} = 0.2
Minimum ... 75°C. ... K_{ss} = 0.0008 ... K_{ss} = 0.015
Use 100 kva. for machines less than 100 kva. rating
Example :- 400 Kva 2,300 volts, 600 R.p.m.
Solution:- (1) from scale D, voltage = 2,300 to B, R.p.m. = 600. (2) from A, Kva = 400, pivot on C to E. (3) from pivot on E to 0.0008 on K_{ss}, Read 2 megohms on R_i
Minimum for class B insulation
Minimum for class A insulation
Pivot Line
Pivot Line
Megohms
Note:- See instructions with data sheet, July number, pages 446 and 447

By Robert W. Wieseman, designing engineer, General Electric Co. (A.I.E.E. Journal, 1934)

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AIR BLOWS DIRT from HEATING SYSTEM RISERS

JUST BEFORE **JUST AFTER**
steamheating mains were blown with air

AS IS customary in all modern heating systems, dirt pockets are provided in the return and supply risers serving the radiators of the Empire State Building, New York, N. Y.

These are short lengths of pipe connected into the tees at the bottom of the risers and closed off at the ends by either 1-in. plug cocks or pipe caps. In the course of time these pockets gradually fill up with dirt and must be cleaned; otherwise steam flow will become sluggish. In fact, in this building some of the risers have been completely stopped up with scale and dirt from the steam main.

There are some 238 return and supply risers varying in size from 1½ to 4 in. in diameter. It can be appreciated that cleaning the dirt pockets in the heels of all these risers is a considerable undertaking, particularly as many of them are in hung ceiling spaces, where it would be dangerous to the men doing the work and likely to damage the ceiling if these pockets were cleaned while steam was on the heating system. With steam on, it would, of course, be impossible to clean those dirt pockets that have only pipe caps. With no pressure on the heating system, it is difficult to get all the dirt out. Often both considerable time and labor is required to work it out through the valve with a wire or other implement.

To make this work easier and to lessen the time required, C. F. Wendland, chief engineer of the Empire State Building, conceived the idea of using compressed air to blow the dirt out through the pockets. This it seemed would possess many advantages. There is no danger to workmen from steam. There is no likelihood of injury to the ceiling from condensed steam or water coming through the open valve, as would be the case when the system is in service. In addition, there are certain places where a horizontal run of pipe precedes the dirt pocket, and the dirt collected there is more likely to be moved and blown out with air than with steam, because it is dry when the air is used.

Rotary air compressors, normally used to operate sewage ejectors, were available to supply compressed air. Three of these were used, two having capacities of 94 c.f.m. each, driven by 10-hp. motors, and the other a 230-c.f.m. compressor driven by a 25-hp. motor, giving a combined capacity of 418 c.f.m.

It was estimated that the heating system piping contained about 25,000 cu.ft. Thus, 7 lb. pressure could be built up in the system within about 15 min. This being a reasonable length of time, and necessary piping changes being simple, it was decided to try out the scheme.

It was only necessary to open the piping between the compressor and the ejector and to insert a tee in the line with a valve, then connect this line to the heating system. This was done conveniently with rubber hose, the conenction being made to an exhaust line from a steam-driven pump. This exhaust line discharges to the main heating system header. The connection for the single large-capacity compressor was made at the inlet to an indirect heater in the basement.

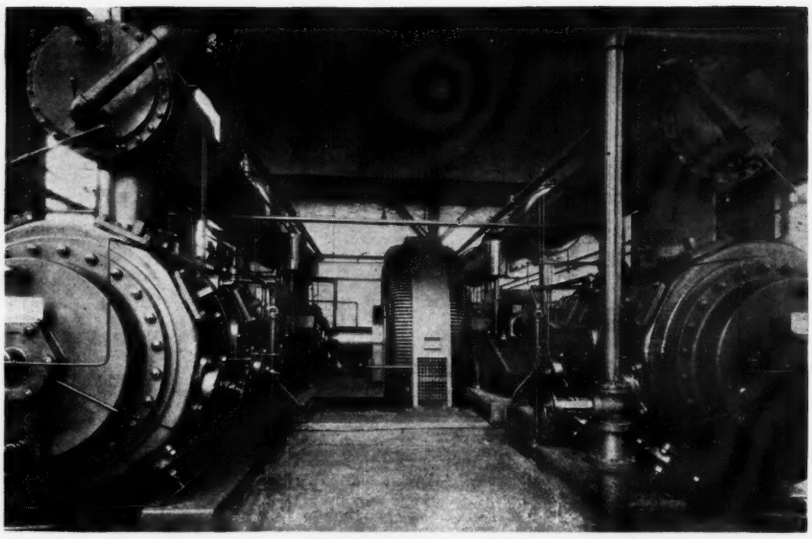
Operation of the rotary compressors requires injection of a certain amount of sealing water, which is carried over with the compressed air into the heating system. In the case of the two small compressors, an excellent separator is provided at the point where the exhaust line joins the main heating system header. The water collecting here is drained to the sewer, thus making it possible to provide practically dry air in the system.

A trial disclosed that 7-lb. pressure could be built up on the system in 12 min., indicating a close estimate of the volume of the heating system. The trial also indicated that pressures of 7 to 8 lb. were in many cases too much and that the dirt could usually be blown out with pressures as low as 3 to 4 lb. All of the return and supply risers that have dirt pockets in the basement have now been blown. The 111 dirt pockets were cleaned in approximately two days of work. Some of these pockets were found clogged tightly and a wire had to be poked up to loosen the dirt. Most of them were found to blow through without any such urging. Most of these lines had never before been cleaned.

All of this work has been done with the regular building staff during the summer months in spare moments. The number of pockets cleaned so far indicates the method to be highly practical, and remaining pockets will be cleaned as time permits.

By C. E. KILBOURNE
and M. N. HALBERG

Industrial Engineering Department,
General Electric Company



A 3,000-hp., unity-power-factor, 125-r.p.m., 6,600-volt synchronous motor driving a gas compressor and arranged for two-step part-winding starting

PART-WINDING STARTING OF Synchronous Motors

A panacea? No, but where it's applicable, this method cuts out auto transformers, resistors, reactors — saves space—lessens maintenance of voltage-reducing unit

PART-WINDING starting of a synchronous motor consists as the name implies, of starting the motor on part of its armature winding, which must be a multiple-circuit type, Fig. 1. When starting, one or more of these circuits is first connected to the power supply, after which the remainder is energized in one or more steps. In this way starting current and starting torque of the motor is reduced, giving the effect of conventional reduced-voltage starting without using an auto transformer, resistor or reactor.

One of the most obvious advantages of part-winding starting is the elimination of auto-transformers, reactors or resistors for starting. Less equipment is required, space requirements are reduced and maintenance of the voltage-reducing device is eliminated.

With part-winding starting the motor circuit is not opened during the starting period, as with the usual auto-transformer starter in which the circuit is opened when transferring from the reduced-voltage to full-voltage taps. Opening and quick reclosure of the circuit to a motor results in a transient inrush of current that, although lasting for only a fraction of a second, may occasionally have an objectionable effect on the power system.

A resistor or reactor starter also provides continuous-circuit starting, but part-winding starting may have a further advantage over either of these types. With certain winding arrangements, the reduction in motor torque with part-winding starting is approximately proportional to the reduction in starting current. This corresponds to the characteristics of auto-transformer starting. However, with reactor or resistor starting, the reduction in motor torque is always proportional to the square of the reduction in starting current. Thus, auto-transformer starting—and in some cases part-winding starting—allows a greater reduction in starting current while maintaining a required motor torque than does reactor or resistor starting.

Part-winding starting is often particularly suitable where more than one reduced-current step is required. It is possible sometimes to divide the stator winding into three, four or even more groups, each of which is successively energized to provide a corresponding number of reduced-current and reduced-torque steps. Although this can be done with auto-transformer starters, it requires rather complicated control. Reactor or resistor starters are comparable to part-winding starters in this respect.

Although part-winding starting has advantages over other types it cannot be used in all cases, as there are limitations to its field of application.

There is an upper limit to the voltage for which it is feasible to design a synchronous motor of a given horsepower rating. Beyond this limit, coil conductors become so small that they tend to produce a coil mechanically weak and less able to stand starting-current stresses. As the horsepower rating of motors increases, both number and size of their coils increase, hence the higher the voltage for which it is feasible to design the machines.

Near the upper voltage limit a one-circuit winding would normally be used. If part-winding starting is to be used the winding must have at least two circuits, thus reducing the number of coils in series in each circuit. This reduces the maximum voltage for which it is feasible to design a motor of a given horsepower rating.

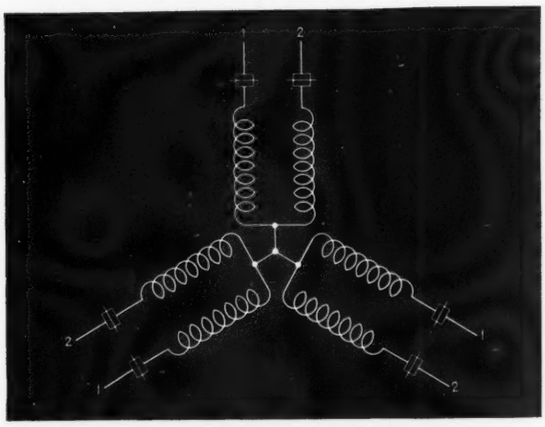
The approximate upper voltage limits for which 60-cycle synchronous motors can be designed for two-step

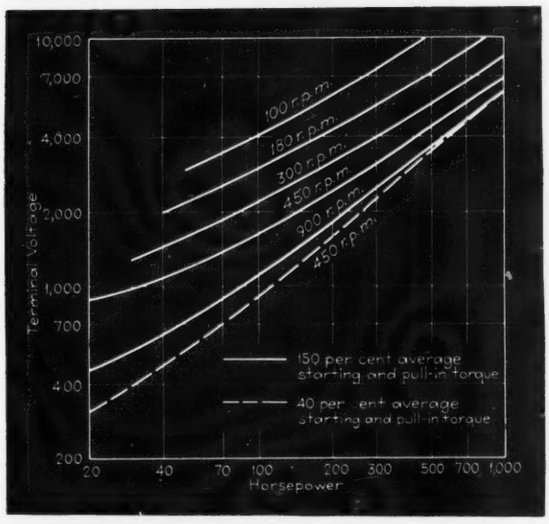
part-winding starting are shown in Fig. 2. Solid curves apply to unity-power-factor machines designed for approximately 150 per cent starting and pull-in torque and the dotted curve illustrates effect of reducing the average torque to 40 per cent. Thus, if the machine is designed for lower torques, the upper voltage limit is lowered; and if designed for leading power factor or higher torques than given in the curves, the voltage limit is raised.

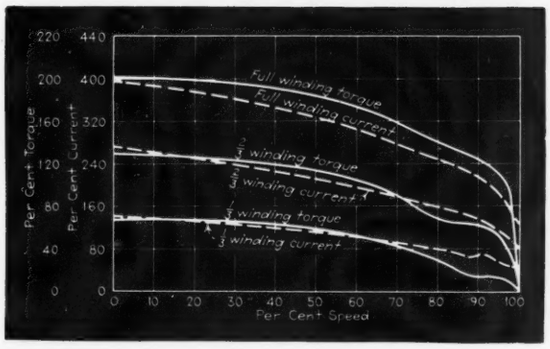
If part-winding starting with more than two steps is required, the motor must be wound for more than two parallel circuits, and the upper voltage limit is reduced. This assumes that the winding is essentially balanced on each step. The number of circuits provided in a machine should be an integral divisor of the number of poles.

When balanced-phase characteristics on each step are not of importance, it is possible to obtain a multiplicity of steps by closing phases in each circuit individually. Thus, a two-circuit machine could have one circuit closed for the first step and then have one or more phases in the second circuit closed to obtain the remaining steps. The magnitude of unbalanced currents on some of the steps may be objectionable.

Fig. 1 (Top)—Typical armature winding of synchronous motor arranged for two-step, part-winding starting. Fig. 2—Approximately upper-voltage limits for which two-step, part-winding motors may be built. Fig. 3—Starting characteristics of a 400-hp., 300-r.p.m., 440-volt, three-step, part-winding-starting synchronous motor using concentrated-winding connections







Starting Current and Torque

The current taken and the torque developed by a motor when started with only part of the armature winding energized depends upon what percentage this part is of the complete winding. If one-half of the winding is energized at the start however, (two-step starting) the starting current and torque are not necessarily reduced to fifty per cent of full-winding value. Actual reduction in current and torque depends upon a number of factors, particularly the arrangement of the coils in the energized circuits.

The usual method of connecting a multiple-circuit armature winding is to connect all coils comprising certain poles of the winding in individual circuits. For example, with a two-circuit winding, the coils comprising half of the poles would normally be connected in one circuit and the remaining coils in the other circuit. The poles included in each circuit may be selected in a number of different ways. In a two-circuit machine, every alternate pole might be placed in one circuit, or alternate groups of two or more poles might be used in one circuit with the remaining alternate poles or groups of poles in the other circuit. This winding connection can often be used for part-winding starting. When used, the reduction in current and torque depend to a large extent upon the number of adjacent poles which are energized in each group. In the extreme case where every alternate pole is energized, starting current is reduced to approximately 60 to 70 per cent of full-winding current and starting torque is reduced to 50 to 60 per cent of full-winding torque.

On the other hand, if the energized poles consist of groups, each comprising two or more poles, current and torque are reduced approximately in proportion to the percentage of the winding energized. With fifty per cent of the winding energized, current and torque will be approximately one-half full-winding values. This relation holds more closely the greater the number of adajacent poles included in each group and also the larger the percentage of the winding energized .

One possible objection to the above connection methods is that they may result in low points on the torque-speed curve of the motor. Dips are in general more pronounced the fewer the number of adjacent poles energized as a group and the smaller the percentage of total winding used. The greater the number of poles in a machine the more suitable does the connection become. For machines having 24 or more poles it is usually the ideal arrangement. In this case the torque dips are of negligible value, as shown by the curves of Fig. 3.

For machines having ten poles, or less, these connections are not so generally applicable, largely because

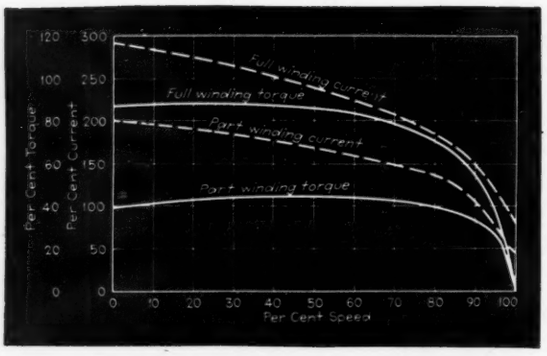


Fig. 4—Starting characteristics of a 3,000-hp., two-step, part-winding-starting synchronous motor using distributed-winding connections

of possible torque dips that will prevent the motor accelerating beyond the speed at which they occur. Of course, for some applications the presence of torque dips is not objectionable, for example, where the motor is not expected to start until the complete winding has been energized.

For applications which require motors having a small number of poles and in which acceleration must occur on part-winding, a different connection arrangement is generally used. Usually the coils in this grouping occupying alternate slots in the machine are connected in one circuit and the remaining coils in the other circuit. With this arrangement the starting current varies between 70 and 80 per cent, and the torque between 45 and 65 per cent of full-winding value (See Fig. 4). This grouping is seldom applicable when part-winding starting with more than two steps is required.

A third connection used is essentially a combination of the arrangements just described and is particularly suitable for machines having relatively few poles where more than two starting steps are required. On the first steps, coils occupying alternate slots of certain pole groups are energized. On the second step, the remaining coils of the same pole groups are energized. The remaining pole groups of the winding are then energized in a similar manner. On the first step of a four-step arrangement of this type, the current may be about 40 per cent of full-winding values. On the second step, the torque and current would be approximately 50 to 60 per cent of the full-winding values, and so on.

In general, the part-winding method of starting should be given consideration in all applications where conventional reduced-voltage methods would be considered, that is, where a reduction in the full-voltage torque and current characteristics of the motor are desirable.

In many cases, part-winding starting may be used to advantage even though full-winding motor torque is not greatly in excess of that required by the load. For example, on some power systems, full-voltage, full-winding starting current is not objectionable provided it is built up in steps not exceeding a certain amount with a time interval between each step. This time interval allows the voltage regulators to act and maintain voltage. Part-winding starting is admirably suited for such an application.

In other cases a high starting torque is required by the load, but to prevent excessive shock to the driven machine or too rapid acceleration it is desirable to build up motor torque in two or more steps. Flour-mill lineshafts are typical of such applications where part-winding starting has been successfully applied. Other applications include rubber mills, ball and tube mills, pulp grinders and metal-rolling mill drives, reciprocating compressors, motor-generator sets, and centrifugal pumps.

By-Product Kilowatts from Hot Water

By H. V. SCHOEPFLIN
Westinghouse Electric & Mfg. Co.

A HIGHLY economic application of the steam turbine and one which has not been accorded the consideration it merits in many cases is that of heating water. In large central generating and heating plants, steam exhausted or extracted from turbine units has long been used for heating boiler feed water, but the advantage to be had in those industrial plants requiring large quantities of hot water in their processes has frequently been overlooked.

Since all heat in extracted or exhaust steam is recovered in the water-heating process, it is possible to generate a kilowatt hour of electrical energy with the expenditure of only 3,550 to 3,800 B.t.u. in steam from the boilers. A good average value for machines of 2,000-kw. capacity and larger is 3,600-B.t.u., and this, basing the calculation on 80 per cent boiler efficiency and coal of 13,500 B.t.u. per lb. gives a coal rate of about $\frac{1}{3}$ lb. per kw-hr.

The water-heating turbine unit is particularly valuable in the chemical, textile, and textile dyeing industries, where the demand for hot water is great. A double saving is effected in those instances where the method of filling the vats with water heated in the power house replaces the older and wasteful method of obtaining hot water by introducing steam directly into the vats to raise the water temperature. There is a greatly decreased radiation loss when hot water is circulated rather than steam, as well as a considerable saving in time. Cases on record show former methods requiring twenty to forty minutes to bring a vat of water to the proper temperature as compared with a time of less than five minutes to fill the same vat with water which has been heated in the turbine plant.

Heaters may be either of the surface or the direct mixture type. The latter, which is no more than a jet condenser operating at pressures approximating

that of the atmosphere instead of vacuum, is less costly than the surface type and is generally preferable when the conditions are such that a non-condensing turbine may be used for the water-heating process. Where the load to be generated is somewhat in excess of that available from a non-condensing cycle, the turbine may be extended into the condensing region and two stages of heating used. This arrangement calls for surface-type heaters, and the first-stage heater then becomes the condenser for the turbine exhaust steam, being designed usually for vacuum of from 20 to 26 in. of mercury. The process water is in this case the circulating water for the condenser and is further heated in the second-stage heater, likewise of the surface type, for which steam is provided by a non-automatic bleeder point in the turbine at a stage where the pressure is approximately atmospheric. As examples of what has been done in two industrial plants, the following are cited:

Exhaust Steam Heating

In a large dyeing plant, two non-condensing turbine units of 2,5000 kw. capacity have been in successful operation for a number of years. A diagram of the arrangement is shown in Fig. 1, a single unit being shown for the sake of simplicity.

Each turbine exhausts into a jet-type heater where the filtered water for the dye vats is mixed with the exhaust steam. The heater is self-contained with its pump and operates at about atmospheric pressure. Since the water supply at this plant is variable through a wide range, storage tanks of large capacity are provided for both hot and cold water. Under night and week-end conditions, when the demand for heated water is zero and the electrical load is only the small amount needed for lighting and essential auxiliaries, the turbine exhaust is used to heat water for storage. Hot water is then available for immediate filling of the vats when the dyeing department commences operation on the following morning. Thus no heat is lost excepting in radiation.

During normal operation, the demand for hot water always exceeds the amount that can be heated by the turbine exhaust. The jet heater is of sufficient size to heat all of the water, however, and necessary makeup steam is obtained either directly from the boilers or from the auxiliary turbine exhaust line.

The auxiliaries, pumps, etc., are steam driven, and normally exhaust into an open heater for the boiler feed. By reference to the diagram it will be seen that this is an extremely flexible arrangement, since an excess of auxiliary exhaust steam may always be used in the process-water heater, thus reducing the amount taken directly from the boilers for makeup, or a deficiency for feed heating can be made up by drawing on the boilers.

Even during periods of curtailed production, this plant has been operating at high efficiency. With only one turbine unit in use, and this at an average load of about 1,400 kw., supplying fifty-nine million gallons of heated water in a typical month, the power cost has been less than 4 mills per kw.-hr. Under conditions of 100 per cent production, the figure is nearer 3 mills, and this despite the fact that fixed charges are somewhat higher than ordinary in this plant, due to the costly water storage and elaborate piping systems required.

The arrangement shown in Fig. 2 is that in use in a carpet mill. The old power plant comprised low-pressure boilers and condensing turbine units which have been incorporated in the new system as standby. The new boiler plant and turbine installation operates at 400 lb. pressure.

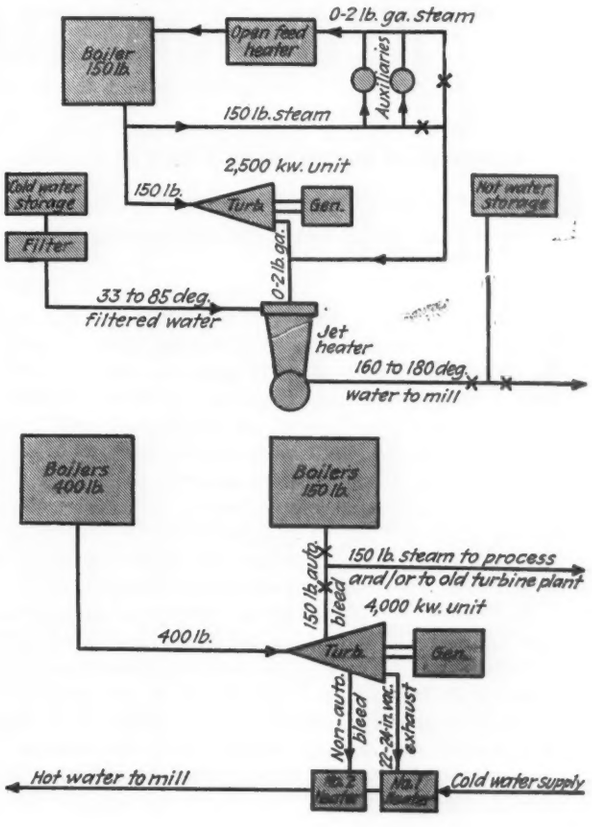
Here the turbine unit is of 4,000-kw. capacity and is of the condensing type, with one automatic extraction point at 150 lb. pressure and one non-automatic point at about atmospheric pressure. Process water is heated initially in the condenser or first-stage heater, this being of the surface type with conventional air removal and pumping equipment. It is heated to the final temperature in the second-stage heater, likewise of the surface type, utilizing steam extracted from the non-automatic point in the turbine.

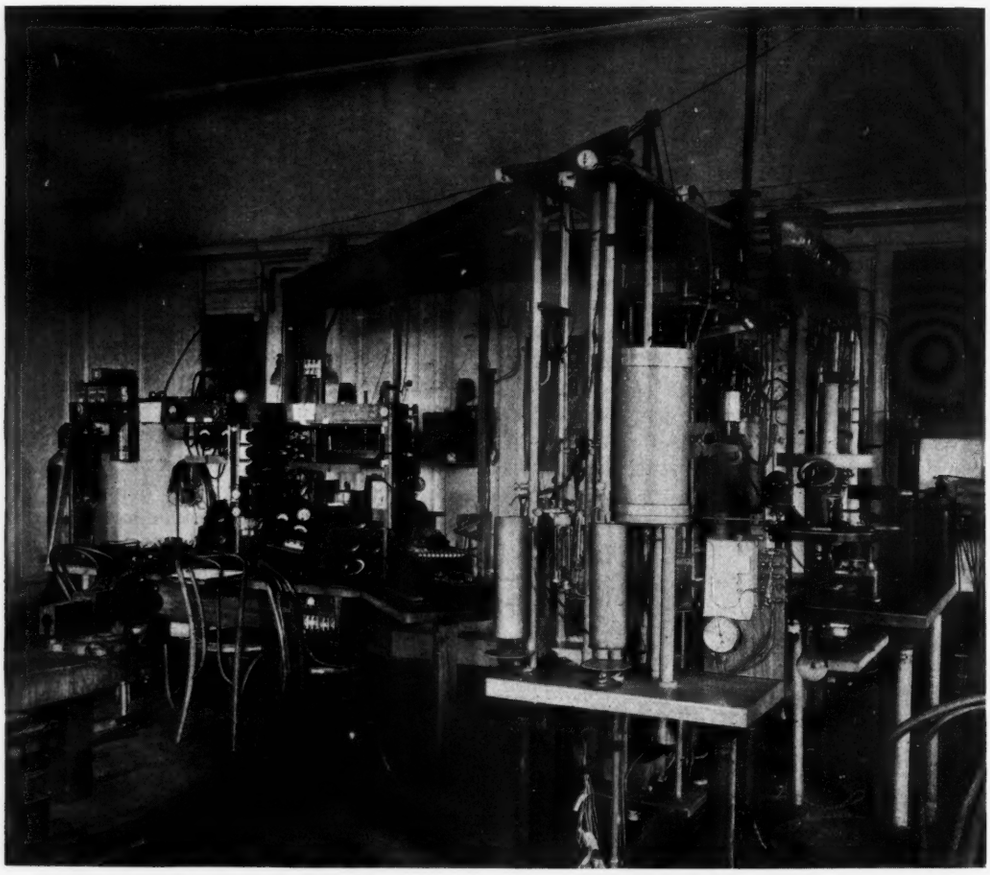
Steam bled automatically from the turbine may be used either for process or for operation of the old turbine plant as occasion demands.

The 4,000-kw. turbo-generator is provided with an air cooler through which a portion of the process water is circulated, thus recovering that part of the generator loss which is transformed into heat. With the old boiler and turbine plant shut down as it now is, and all of the load carried on the new plant, the only heat wasted is the inconsequential amount carried off in the turbine gland water.

An important point is that no special apparatus is required in the sort of installation under consideration. Heaters of both the jet and surface type are available as standard equipment, and turbine units for non-condensing or single or multi-stage bleeding are readily obtainable.

Fig. 1 (Top)—Diagram of process water heating in a dyeing plant. Fig. 2—Diagram of two-stage process water heating in a carpet mill





Here is the set-up: Left, electrical measuring instrument; Center foreground, boiler and accessories; Right, deadweight gage

JUST ANOTHER BOILER TEST

Evaporation measured to 1 part in 10,000. Water heated electrically. Boiler and weighing tanks of rare metal

IT IS considered good practice when a large boiler or one of a *new type* has been installed to make a thorough test of its performance. Such a test is usually a special event, requiring a large number of observers, a great number of weighings and instrument readings, and extensive calculations, which ordinarily lead to a result fairly close to that anticipated. In a recent test of a high-pressure boiler installed at the National Bureau of Standards, some unusual precautions were taken to ensure the high degree of accuracy which is expected of this institution.

The boiler was designed to operate at pressures as high as 3,200 lb. and at the corresponding temperature of 705 deg. F. Tests were made at pressures ranging from about 600 lb. to 3,200 lb. For the purpose of the tests heat was supplied to the boiler by a metal-clad electric heating coil immersed in the water. By this means the quantity of heat supplied could be measured accurately.

Steam was withdrawn through a valve of special design where its pressure was reduced to that of the condenser vacuum of about 29 in. The valve was continuously under the control of an operator who kept the pressure within the boiler as nearly constant as practicable, although occasional variations as great as a few tenths of a pound per square inch had to be tolerated when working at the higher pressures. Temperature of the steam leaving the boiler was observed very frequently throughout the tests, to detect any departure of even a few hundredths of a degree from saturation. Steam was condensed in special weighing tanks, and the amount of water condensed was weighed within one part in 10,000.

Blow-down tests were also made in a similar manner, except that water was withdrawn, instead of steam.

Special precautions were taken to reduce the "losses unaccounted for," the most important source of which would have been the heat lost from the boiler surface. Thermocouples connected in series were installed all over the boiler surface, and the junctions were spaced so closely that the average temperature of the surface could be accurately determined. A metal shell was erected to completely inclose the boiler, and thermocouple junctions, corresponding to those on the boiler,

were installed on this shell. During tests the shell was heated. By use of the thermocouples, the heating was regulated to keep the average temperature of the shell about the same as that of the boiler surface.

The design and proportions of this boiler and its accessories were chosen, not with reference to economical generation of steam, but with the object of carrying out the thermal processes of steam generation devoid of the usual factors of uncertainty. At the Bureau of Standards, the boiler is known as a calorimeter. It holds somewhat less than a pound of water, and the maximum rate of delivery is about a half-pound of steam per hour. The weighing tanks are of pure silver, and the metal shell around the boiler is also of pure silver, $\frac{1}{4}$ in. thick.

No point on the boiler surface is as much as 2 in. distant from a thermocouple junction, and the average temperatures of the shell and boiler are kept the same within a few thousandths of a degree during tests. There is no feed-water pump, so that experiments must be made with the quantitiy of water that can be put into the boiler before it is heated.

These experiments are part of the international program sponsored in this country by the American Society of Mechanical Engineers. This program is intended to provide new and more accurate data on the thermal properties of water and steam, particularly at high temperatures and pressures, as a basis for improved tables for the use of boiler testers and others interested in the properties of steam.

This boiler alone can be and has been used in most of the measurements required to determine the quantities given in a steam table under the heading "Properties of Saturated Steam." Properties that can be directly deduced from the measurements made include the pressure corresponding to any temperature, the specific volumes of saturated liquid and vapor, the heat content and entropy of the liquid, the latent heat and entropy of vaporization and the heat content and entropy of the vapor. The boiler could also be used, although it is not so well adapted for the purpose, for volumetric measurements of the specific volume of the liquid, or of the superheated vapor. Such measurements of volume of liquid and vapor were, however, made at the Massachusetts Institute of Technology with apparatus especially designed for the purpose.

It may be expected that the experimental work on properties of saturated steam, and the volumetric measurements on superheated steam will be completed, and available for calculation of steam tables, by the end of the present year. A table based on data then available would not, however, be well balanced, since the calorimetric data on superheated steam are not as complete as those relating to saturated steam. The table would be comparable to a test report on a steam-power plant, in which the boiler tests had been very thorough and complete, while the tests of the rest of the plant did not cover the entire range of operation. There is urgent need for additional calorimetric work on superheated steam, and while no definite provision has yet been made for such work, it is to be hoped that the means necessary to carry on may yet be found.

Charlesworth Gives Data On Utility Diesel Plants

Diesel operating cost figures for ten small utility plants during 1932 have recently been released by George Charlesworth, electrical engineer of the Iowa Railroad Commission. These figures extend the 1931 figures presented by him at the tenth annual conference of utility commission engineers held in 1932. Ranging in load factors from 33.33 per cent (585-kva. plant No. 4) to 8 per cent (1.025 kva. peak-load plant No. 10) the costs per net kilowatt-hour range from $0.0193 to $0.0595. One plant (No. 1) has a large margin of capacity over peak load and shows the high cost of $0.0843 per net kilowatt-hour.

Output Consumption and Costs for Utility Diesel Plants

Plant No	1	2	3*	4	5	6	7	8	9	10
Size units in kva	1-237; 1-75	1-300; 1-200 1-75	2-513	1-585	3-513; 1-250	3-600	2-512; 1-375	1-690	1-690	1-525; 1-300 1-200
Type	2c; SI 4c, AI; 2c, SI; 2c, SI		4c; AI	4c, AI	4c; AI; 2c, SI Full Load only	2c, SI	4c, AI	2c, AI	2c, SI	2c, SI
Operation	Isolated	Isolated	.....	.....		†	Base Load	Peak Load	Peak Load	Peak Load
Total kw.-hr. generated	210,470	661,930	2,121,600	1,409,410	1,751,200	2,721,770	2,422,980	588,300	495,200	388,590
Kw.-hr. light and power	7,762	37,170	51,593	27,919	17,398	88,616	81,834	13,100	12,980	8,980
Kw.-hr. station losses	8,603	11,780	5,125	23,206	13,389	36,054	14,075	.....	.....	.....
Net kw.-hr. for use	194,105	612,198	2,064,882	1,358,285	1,720,413	2,597,100	2,327,071	575,200	482,220	379,610
Station capacity, kva	309	575	1,025	585	1,789	1,800	1,399	690	690	1,025
Maximum demand, kw	75	250	920	480	1,700	.....	1,100	610	560	550
Fuel oil used, gallons	38,111	82,300	203,814	128,355	148,265	286,583	234,664	56,995	46,348	35,314
Cost of fuel oil	$1,382.59	$2,987.25	$7,569.45	$4,844.97	$5,846.63	$10,139.43	$8,789.38	$2,016.65	$1,628.33	$1,304.54
Cost of fuel oil f.o.b. plant	$0.036	$0.036	$0.037	$0.038	$0.039	$0.035	$0.037	$0.0353	$0.0351	$0.0369
Net kw.-hr. per gal. fuel oil	5.1	7.44	10.1	10.6	11.6	9.1	9.9	10.3	10.7	10.7
Gallons lubricating oil	1,122	1,544	1,483	701	1,519	3,276	2,319	420	403	428
Cost of lubricating oil	$0.527	$0.537	$0.526	$0.53	$0.508	$0.514	$0.514	$0.499	$0.65	$0.48
Net kw.-hr. per gal. lub. oil	173	397	1,392	1,938	1,133	793	1,004	1,400	1,197	887
Itemized Costs per Net Kilowatt-Hour										
Int. at cost of money	$0.0274	$0.0163	$0.0070	$0.0062	$0.0132	$0.0092	$0.0078	$0.0126	$0.0142	$0.0277
Wear on 20-year life	0.0136	0.0080	0.0035	0.0031	0.0067	0.0045	0.0040	0.0062	0.0069	0.0133
Taxes	0.0093	0.0030	0.0016	0.0015	0.0003	0.0015	0.0002	0.0034	0.0043	0.0074
Fuel oil	0.0071	0.0049	0.0037	0.0036	0.0032	0.0039	0.0038	0.0035	0.0034	0.0034
Lubricating oil	0.0030	0.0015	0.0004	0.0003	0.0004	0.0006	0.0005	0.0004	0.0005	0.0005
Operating labor	0.0110	0.0050	0.0017	0.0031	0.0016	0.0013	0.0017	0.0020	0.0019	0.0038
Water	0.0001	0.0005	0.0002	0.0002	0.0001	0.0001	0.0001	.....	.....	.....
Maintenance	0.0121	0.0007	0.0010	0.0013	0.0008	0.0008	0.0011	0.0019	0.0018	0.0010
Insurance	.....	.....	.....	.....	.....	.....	.....	0.0010	0.0009	0.0020
Miscellaneous	0.0007	0.0005	0.0002	0.0005	0.0001	0.0005	0.0003	0.0002	0.0002	0.0004
Total power costs	$0.0843	$0.0404	$0.0193	$0.0198	$0.0264	$0.0224	$0.0195	$0.0312	$0.0341	$0.0595

*Has reserve capacity for No. 4. †As reserve for three transmission systems. Legend: c = cycle; SI = solid injection; AI = air injection

Hard-facing a 9-in. valve disk for high-temperature, high-pressure steam service with a non-galling, non-ferrous alloy of cobalt, chromium and tungsten especially resistant to abrasion, corrosion and erosion. The facing will retain its inherent hardness at red heat. After pre-heating to 1,100 deg. F., the disk is faced with a ⅛-in. layer of alloy, then reheated to 1,250 deg. and furnace-cooled.

Photo courtesy Haynes Stellite Co.

STEAM HEAT IN 1812

"QUAKERS," members of the Society of Friends, have always been noted for good practical sense as well as for sobriety and integrity. Thus, back in 1812, Friend Jon A. Ellicott writes sanely about steam heating to Friend Charles Shoemaker of the Westtown School. The letter was sent to Power *by S. Howard Pennell of Philadelphia.*—EDITOR.

1st Mo. 6th, 1812.

ESTEEMED FRIEND, CHARLES SHOEMAKER:

I received the favour of the 23rd of last month on the subject of heating the Westtown School with steam. I believe you were correctly informed that the heat communicated to a room from steam is more agreeable than from stoves. The supt. of the factory could not inform me of the daily consumption of wood, but I have no doubt of its being much less than would produce the same heat by stoves. The heat of the factory when I was there today, which was a cold day, was just such as I could wish from the natural temperature of the air, and appeared entirely equal in all parts of the house, an advantge which I have not observed in any other way of heating a building. The exact expense I could not obtain, but I should apprehend the expense not more than a sufficient number of stoves would be. The consumption of water is probably not a barrel a day.

In order that thee may form an idea of the proper size of Boiler, and apparatus for heating your building, I give the size of the factory building, which is 100 feet by 37 in the clear, five stories high with a garret; the height of the stories is 11 feet, the boiler is 6 ft. diameter, and 5 ft. in height, to be wider it is supposed would be an advantage, it is made in the common form of other steam boilers (of which you have several in Philadelphia) with the same apparatus for feeding and regulating it.

The boiler is fixed on the outside of the building with a horizontal cast iron pipe therefrom until it reach the middle of the gable end of the building, attached to that is a perpendicular until it reach the proper height for the upper floor of the building, the diameter of this pipe should be about 6 inches in the clear of the bar, which may be cast as thin as it can be got. Copper pipes are to be fixed to a projection from the cast iron pipes fixed by screw bolts by means of flanges round the edges of both pipes. This Copper pipe is to be 7 inches diameter, and is supported along the middle of the house to the other end, giving an elevation of 12 or 18 inches, so as to carry the condensed steam back to the other end where it communicates to a small copper pipe of one and an half inch diameter, which small pipe conveys the condensed steam back into the boiler. Each Horizontal pipe communicates with the small perpendicular tube. Each of the Horizontal pipes at their further end terminates with a tin tube affixed to it, ending at one-eighth of an inch diameter, so as to emit and keep up a steady current of steam. By having this pipe larger in diameter and with a common crane cock more or less steam may be emitted at pleasure, and this steam may be discharged at a door or window or any other convenient place.

I now will observe that the foregoing description is calculated for warming each story of a building without any other rooms, but in case there are other rooms, smaller pipe in the same manner as those already mentioned and that there must either be a descent into the small returning pipe, or be discharged into the cellar out of doors or some other way. This small pipe to convey the steam into a room or to communicate with a pipe or barrel of sufficient dimensions to communicate sufficient heat to the room or apartment, the size of it may be determined by calculation of the size of the house that is heated by the before mentioned size of pipe. It may be observed that this factory has a window of 24 lights and 26 of them in each story. Which in all probability gives more external air than the rooms in your school house will have, this ought to have some weight in calculating so as to give the proper degree of heat to all parts of your house.

It is a matter worthy of consideration whether this is the most economical way of producing the necessary quantum of steam. There are patents taken by Timothy Kirk, and perhaps others, the particulars of which I am not much acquainted with. If on a further investigation of the subject, you should conclude on this mode of heating your house, and I have not been sufficiently explicit, only inform me, and any question that I can, I shall take pleasure in answering. There is a person here by name Wm. Richardson, who would come, if necessary, and you thought proper, and direct the whole operation. He is a man who may be depended on.

Thy Real Friend,
JON A. ELLICOTT.

Auto Engine Makes Small Power Plant

At Lummi Island, near Bellingham, Wash., there is no regular supply of power available for the several hotels on this popular seaside island. This difficulty has been overcome for Loganita Lodge by C. R. Granger, owner and manager, who has built a useful lighting plant from an old Model T Ford with a Westinghouse d.c. generator of about 15-kw. capacity.

He took the chassis frame of an old Model T, welded angle-iron legs to it and mounted it on a timber foundation. To this he bolted the generator, connected by a flexible coupling to the engine, with a governor attached to set the speed at 1,200 r.p.m. The radiator was removed and cooling water for the engine run into two large galvanized tanks which automatically supply hot water for use in the laundry, kitchen, and wash basins. The unit runs quite smoothly, operates about 18 hr. per day, and has rarely given trouble. There is a smaller 1-cyl. Delco unit held in reserve, but it is seldom required.

This plant lights the main building, recreation hall, several cottages and outbuildings, barn and chicken run, and grounds. It also furnishes power for the laundry and to pump water from the wells to the supply tank.

Contract has recently been placed by Victoria Falls & Transvaal Power Co., Ltd., for generating plant equipment to be installed in the new Klip River station, South Africa, with the Metropolitan-Vickers Electrical Co., Manchester. The contract covers the supply of three turbo-alternator sets, each of 33,000-kw. capacity, complete with condensing plant. The turbines will be of the 2-cyl. impulse type, the low-pressure cylinder in each case being designed for double flow of steam exhausting into a twin condenser of the central flow surface type.

ACCURATE MEASUREMENT OF HIGH GAS TEMPERATURES

By H. F. MULLIKIN, Ph.D.
Yale University

AN ORDINARY thermocouple junction inserted in a furnace or duct carrying high-temperature gas can "see" the relatively colder walls. The thermocouple junction, although but a few hundredths of an inch in diameter, will radiate heat to this colder surface and thus will be cooled below the true temperature of the surrounding gas. The resulting error may, at furnace temperatures, amount to two or three hundred degrees.

This difficulty may be overcome by the use of a special "high-velocity" thermocouple that has a heat insulating shield around the tip so that it will be able to "see" only a small portion of the cold walls. A stream of the hot gases is then aspirated past the junction of the thermocouple at a high velocity. This further increases the heat transfer from the gas to the thermocouple tip, thereby causing the reading to approach closely the true gas temperature.

A new high-velocity thermocouple, designed for practical boiler room use, has been thoroughly tested in numerous boiler furnaces fired by pulverized coal, stoker, oil and gas, at temperatures up to 3,000 deg. F. Details of the assembly as well as the construction of the water-cooled holder are shown in Figs. 1 and 2. A refractory porcelain tube is placed around the hot junction of the thermocouple and serves to shield it from the cold walls of the tube. Metal protection shields are not satisfactory. The insulators shown were adopted, after tests, to prevent possible contamination of the thermocouple, and to overcome the tendency of the thermocouple to become completely slagged when used in pulverized-coal furnaces. In operation, the outside insulator soon receives a coating of liquid slag which fuses with the porcelain. Where the slagging is very pronounced, it is necessary to renew the outside insulator quite often. The ease with which this may be done is a feature of the thermocouple.

For temperatures over 2,500 deg. F. a platinum-rhodium thermocouple should be used. Due to the high cost of this wire, compensating leads of alloy wire are welded to short lengths of the platinum wire at W and are in a relatively cooler zone.

For the remainder of the length of the thermocouple beyond the dimension x in Fig. 1, it is advisable to surround the insulators with a ¼-in. O.D. brass tube to prevent moisture from the gases, or from breaks in the high-velocity thermocouple water-jacket pipe, from setting up a battery action which would cause erratic readings.

The thermocouple should be electrically welded, small alternating current welders being available for this specific purpose. Oxy-acetylene welds are unsatisfactory, as they tend to make the wire brittle.

The aspirators are not mounted on the end of the high-velocity thermocouple, as their weight would cause difficulty in handling. Instead, hose connections are made to the aspirator.

If desired, the high-velocity thermocouple may also be used for taking gas samples for Orsat analysis, it being necessary to reduce the aspiration so that the sample can be withdrawn.

The thermocouples are subject to frequent breakage within an inch or two of the hot junction when used at high temperatures. A considerable length of wire is coiled up at the outside end of the thermocouple, and whenever the thermocouple wire is broken it is a relatively simple matter to uncoil the amount needed, move the insulators back, and make a new weld.

Sufficient water should flow through the tubing so that it is not too hot to place the hand on the outlet pipe, the water lines being so hooked up that the outside tube is connected to the drain.

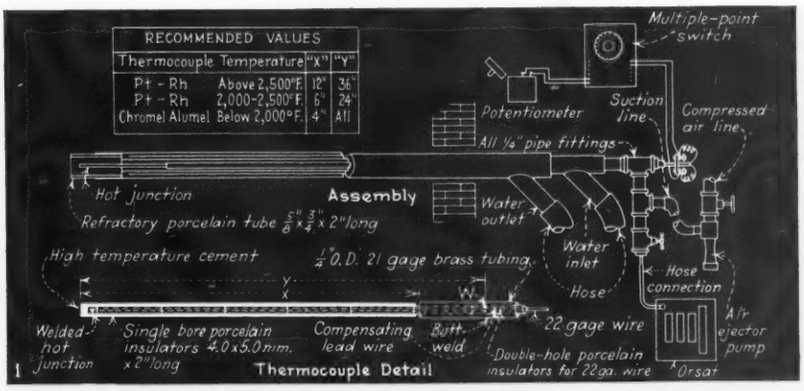
As the gas velocity is gradually increased, the temperature indication given by the thermocouple will also increase. The amount of increase gradually becomes less until, at some value of gas velocity, further increase does not result in an increased temperature indication. This is shown in Fig. 3. When taking readings, the gas velocity must always be greater than this value. It takes about one minute for the thermocouple to reach full reading after the suction has been turned on.

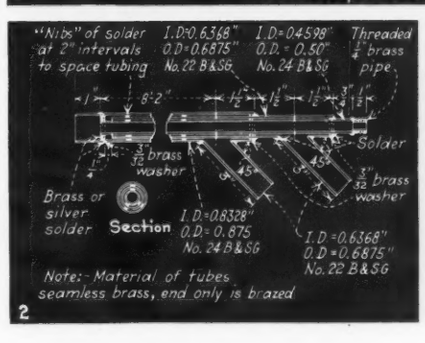
Cold-junction corrections are made as in ordinary thermo-electric practice.

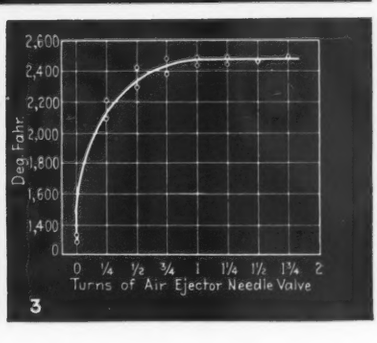
The suction should be "on" only during the time that readings are being taken to avoid filling the fire end with ash particles. When particles do lodge in the fire end, they can sometimes be removed by putting the hand over the aspirator exhaust, thus blowing compressed air back through the high-velocity thermocouple tube. This should be done with caution to prevent blowing the insulators off the end. If it is badly stopped up, the high-velocity thermocouple should be removed from the furnace and the sintered ash removed by means of a bent wire.

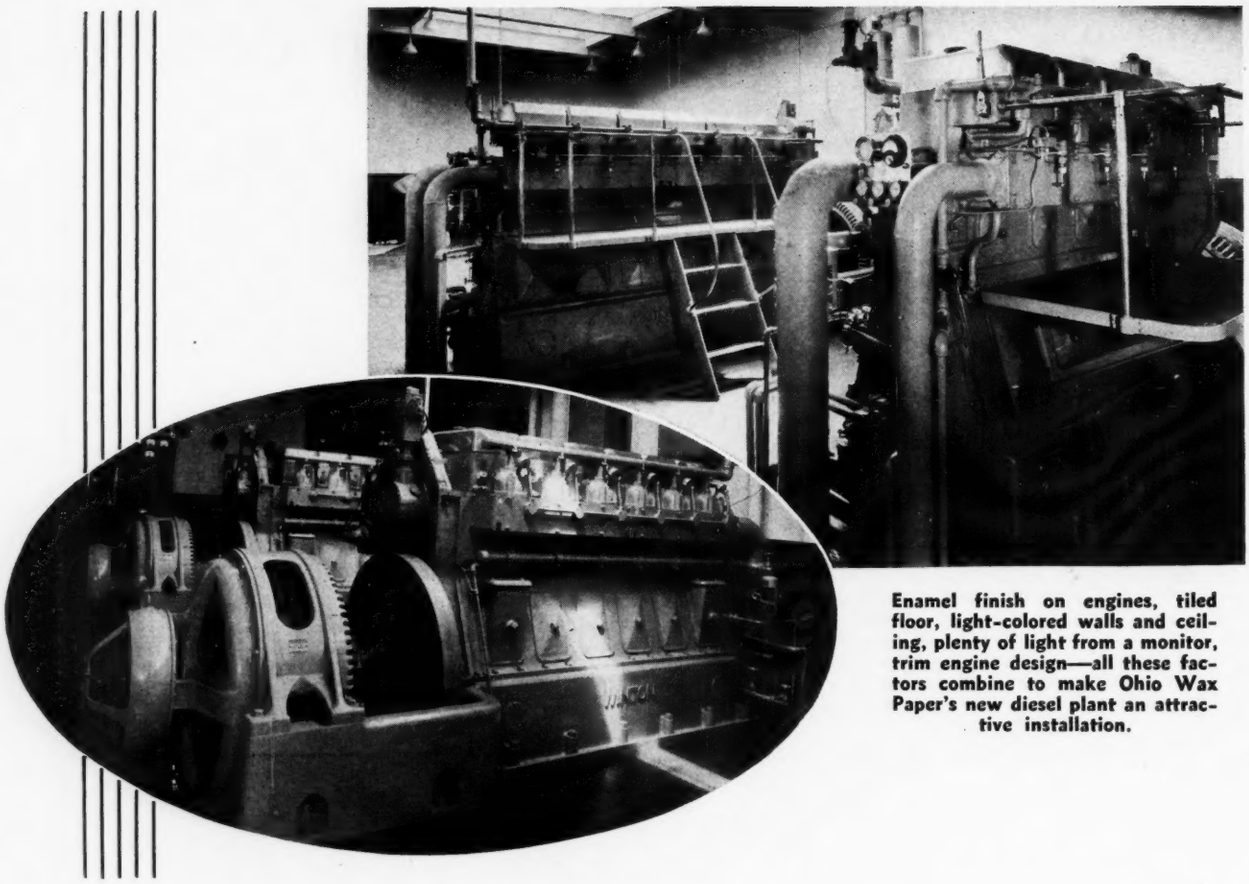
In gas and oil-fired furnaces the high velocity thermocouple assembly may be left in indefinitely. In the cool boiler passes of coal burning furnaces there is very little difficulty encountered. The greatest amount of difficulty will be met with in the furnace proper of coal burning units. Hence it is generally necessary to insert the high velocity thermocouple only long enough to obtain a reading, it being then removed and cleaned if necessary.

Fig. 1—Detail of high-velocity thermocouple arranged for use with Orsat. Fig. 2—Detail of water jacket for thermocouple. Fig. 3—Influence of gas velocity past thermocouple on temperature readings




"Nibs" of solder at 2" intervals to space tubing
I.D.=0.6368" O.D.=0.6875" No. 22 B&S G.
I.D.=0.4598" O.D.=0.50" No. 24 B&S G.
Threaded ¼" brass pipe
Solder
3/32" brass washer
Brass or silver solder
Section
I.D.=0.8328" O.D.=0.875 No. 24 B&S G.
I.D.=0.6368" O.D.=0.6875" No. 22 B&S G.
Note:- Material of tubes seamless brass, end only is brazed
2





Enamel finish on engines, tiled floor, light-colored walls and ceiling, plenty of light from a monitor, trim engine design—all these factors combine to make Ohio Wax Paper's new diesel plant an attractive installation.

WAXED BY DIESEL

IT IS a far cry from sliced bread to diesels, but the twain have met in the plant of Ohio Wax Paper Co., Columbus, Ohio. For this company waxes and prints paper of a special type to keep sliced loaves fresh, and has just installed a diesel plant to supply all power. Two 400-r.p.m. 4-cycle Winton diesels of the latest design, one 250-b.hp., 6-cyl., direct-connected to a 166-kw. generator with direct-connected exciter, the other 165-b.hp., 4-cyl., direct-connected to a 110-kw. G.E. generator and direct-connected exciter. 60-cycle current is generated at 220 volts.

Frequency is held within 0.5 per cent by Woodward electric synchronizing governors. Full-pressure lubrication, automatic stops in case of failure of either lubricating oil or cooling water, and a common base for engine and generator to insure alignment of moving parts are other features of the installation. Distilled water, secured from a neighboring ice plant, is circulated through the engine jackets and a closed cooling system. Raw water drains from a Binks cooling tower on the building roof to an aerated storage tank from which motor-driven centrifugal pumps pass the water through oil coolers and to the heat exchangers, then back to the tower.

Double circulating pumps integral with the engines circulate lubricating oil through suitable filters and coolers before returning it to the engines. A 15,000-gal. fuel-oil storage tank supplies the 80-gal. day tanks by remote-controlled motor-driven rotary pumps. Fuel oil now being used is Bé 22-34 deg., with 37 sec. Saybolt viscosity at 100 deg., heat value not less than 18,500 B.t.u. per cu.ft., residue not more than 10 per cent, flash point not less than 150 deg. F. Sulphur, water and ash not more than 0.5 per cent each.

Air starting capacity is provided near the engines by a 10-cu.ft. per min. Gardner-Denver unit. Construction, after foundations and building extension, took sixty days.

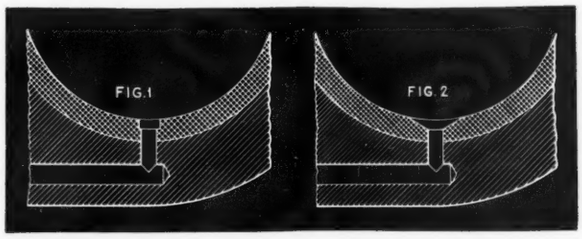
Several statistics of the plant itself may be of interest. Largest waxed bread wrapper manufacturing plant in the world, it can produce each week a sheet of paper 18 in. wide and 33,000 miles long—about $1\frac{1}{8}$ times the distance around the earth at the equator. Included in equipment are two ice machines, one a 30-ton, the other 15-ton, used for general refrigeration and for chilling the water circulated through the waxing machines.

PRACTICAL AIDS TO OPERATION

Why Cut Useless Oil Grooves?

PAGES have been written on oil grooves in bearings, relative to their location, and whether they should be straight or curved. I do not propose to enter into any discussion on these points, but I would like to draw the attention of designers and mechanics to a common fault with oil grooves, regardless of location or shape. Designers, mechanics, inspectors and erectors are prone to overlook the fact that to make oil grooves of value, they must have a generous bevel on their leading side.

This bevel permits oil to be drawn from the groove to form an oil film between the rubbing surfaces of the shaft and bearing. If the designer neglects to call for a bevel on the edge of the groove, the mechanic cuts the groove without a bevel, for that is the easiest form to cut. The inspector accepts the groove, as cut, because



a bevel was not called for on the drawing. The erector installs the bearing as it comes to him, because the time given him for assembling does not allow him to do any fitting. The results are an unsatisfactory bearing that wears quickly and heats under load.

Many horrible examples of bearings having oil grooves with sharp corners can be seen every day. This is particularly true of small brass bushings, such as used on wrist pins. Tests have proved that wrist-pin bushing life can be doubled by changing from sharp-edged grooves to well-beveled edges on the oil grooves. It is every erector's duty, in installing bearings having oil grooves, to see that there are no sharp corners to scrape oil from the shaft. Designers, however, should be more explicit in calling for oil grooves and give a large-scale section drawing of them. This would prevent an otherwise good bearing from being ruined by oil grooves of a shape that makes them defeat the purpose for which they were intended. Fig. 1 shows a common, but improper, form of oil groove and Fig. 2 the proper form having a long, tapered leading edge to draw the oil in between the shaft and bearing.

Sherbrooke, Que. G. F. MCCLAY.

Clean Out the Piping System

THE IMPORTANCE of cleaning out a piping system before putting lines back into service was shown by a recent accident that did considerable damage to turbine blading.

A sectionalizing valve was installed to aid in maintenance of a large steam header serving three turbines in an industrial plant. It was necessary when installing this valve, that the header be cut and a new section of pipe with suitable flanges for the valve welded in place. No provision was made during the job to prevent particles of welding metal from entering the pipe, and after the job no thought was given to cleaning the line out.

Because of this neglect an expensive job of reblading was necessary on one of the turbines. Pellets of metal from the welding were picked up by the steam, carried through the steam strainer and into the first and second stages of the turbine, there seriously damaging the blades.

This occurrence could have been prevented if proper care had been taken to thoroughly clean the inside of the weld after it had been completed, or by the use of a sleeve on the inside of the job to prevent any metal from coming through.

Another case may be cited in which a high-speed, multi-stage, centrifugal exhauster developed an unusual vibration trouble after being in service a few months. Upon dismantling the machine, we found that the greater part of a suit of overalls had lodged in the blading causing an unbalanced condition. The overalls had evidently been left in the suction line during ite erection, and sufficient care had not been exercised to clean out the pipe.

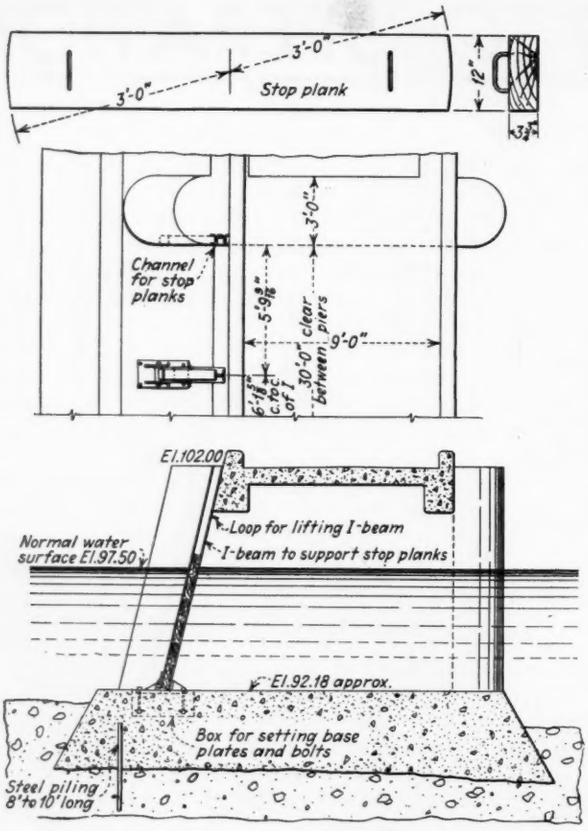
Such ocurrences emphasize the necessity of thoroughly cleaning piping systems before putting them in service, whether they be new lines or old lines on which maintenance work has been done.

Waynesboro, Va. S. H. COLEMAN

Removable Dam for Hydro-Electric Plant

A NEW BRIDGE became necessary for spanning a head race something over 60 ft. wide, and for cases of emergency and repairs it was desirable to have, at the bridge, some means of stopping out the water from the mills below. A series of head gates to extend across the stream was first considered, but the plan was abandoned because of the high cost and the objectionable appearance of the gate stems. The following substitute was proposed and adopted:

A coffer dam was constructed and the site unwatered. A line of steel sheet piling was then driven across the stream, the ends of which were allowed to project some distance above the stream bed, as in the figure. The piling was then capped with a massive concrete mattress extending from shore to shore and made several feet wider than the proposed bridge. On this mattress, concrete shore abutments and a central pier were cast, to support the reinforced-concrete bridge. Parallel to, and several feet upstream from the upstream face of the bridge, a row of castings, spaced at regular intervals, were anchored in the mattress, and to these castings were hinged heavy steel I-beams, to act both as supports and as grooves for stop planks. The I-beam when in operating position had a slope of about 30 deg. from the perpendicular and the top ends were made even with the surface of the bridge curbing. Channel irons were



embedded in the sides of abutments and the central pier to support the ends of the terminal stop planks.

When not required, the I-beams are submerged by pushing them over a short distance out of plumb, when they will, of their own weight, swing down and rest on the bottom. To facilitate swinging the I-beams into place a substantial loop was riveted to the down-stream face of each at a point where it would clear the bottom of the bridge. By the use of a pole with hook attached, it is then a simple matter to raise the I-beam.

The stop planks are 6 ft. long, and so accurately were the I-beams spaced that the planks are everywhere interchangeable. Specially formed staples were inserted in the stop planks to prevent their tilting when being handled with poles having specially constructed hooks. An important feature of the stop planks is that the ends are curved on a radius of one-half their length. This feature obviates any possibility of the planks becoming bound during the process of installing or removing.

This development was made at the plant of the Kezar Falls Woolen Company, Kezar Falls, Me., in 1932, and has since met the requirements of the situation with entire satisfaction.

Milton, N. H. I. W. Jones
Consulting Engineer.

Method for Cleaning Oil Coolers

Oil coolers must be kept clean of scale and sludge. The composition of the scale on the water side of the tubes will depend on the impurities in the water. Much of the scale can be removed by boiler-scaling tools, but the scale in inaccessible places is best removed by a weak hydrochloric acid solution. As the acid solution is passed through the cooler it will dissolve the scale and will turn the solution a milky white. As soon as the solution begins to come out cleaner, this treatment should be stopped so that the metal parts are not attacked. The cooler should then be flushed out with water at high velocity, hot if possible. This will remove acid solution that may remain in the cooler and will also remove any loose particles of scale.

Another way of removing scale that is less drastic than the acid treatment is to make a solution in the proportions of one pound of common soda to one gallon of water. The water space of the cooler should be filled with this solution as hot as possible. Steam connection should be made and live steam admitted to the cooler so that the solution is kept boiling. This treatment is continued for three hours when the solution is drained out and the cooler flushed with water. A great deal of scale will be found to be washed out, as the soda water will have softened and loosened it. If washed out with water at a high velocity, most of the scale will be removed.

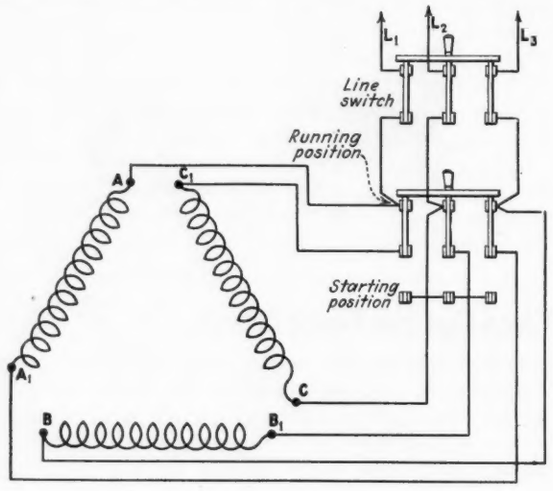
The sludge on the oil side can be removed by a solution made by dissolving one-half pound of caustic potash in each gallon of water used. Bring this solution to the boiling point and fill the oil space with it. Steam should be admitted to the lower part of the cooler, so that the solution is kept boiling to assist any dirt and sludge to rise to the top and overflow. This treatment should be continued until it can be seen that no more impurities are rising to the top. The solution should then be drained off and the cooler well flushed out with water.

Herts, England. W. E. Warner

Emergency Switch for Star-Delta Motor

Recently a 25-hp. induction motor burned out on one of our important drives. A check of the spare equipment available to serve until the motor could be repaired revealed a 25-hp. machine of the same speed but with its windings arranged for star starting and delta running. As the starting switch for this motor was not serviceable, it was necessary to devise some substitute. For this purpose a three-pole double-throw switch was used and the motor connected as shown in the diagram.

With the three-pole closed to the down position winding terminals A_1, B_1, C_1 are connected to form the star.



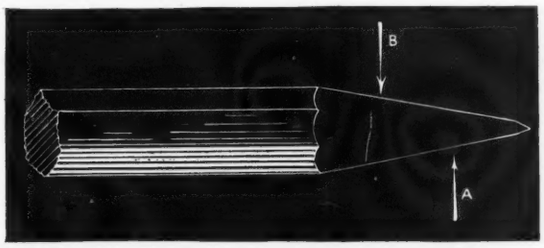
Then, when the line switch is closed the motor starts and comes up to speed. When the motor is near full speed the double-throw switch is closed to the running position and the three corners of the delta are closed. This puts full voltage across each winding for running.

Pittsburgh, Pa. M. R. SMITH

Tempering Cold Chisels

MECHANICS have read much on the temperature that should be given chisels before quenching. The trick is to carry this into practice. On a cold chisel for steel I try to obtain a heat of 530 deg. F. (a light purple, or what I call a pigeon blue) before quenching. For cold chisels to be used on cast iron a temperature of 550 deg. is obtained (a dark purple).

After I heat the chisel, I scrape off the scale so that the true heat color may be seen. Holding the chisel in the shade of the anvil, I watch the dull red come down to the colors mentioned. As the chisel comes to the desired color I dip it quickly in clean water up to *A* until cold. I have found that if it is dipped down to *B* the



chisel will be too hard and will break off. After all, you only require a degree of hardness on the actual cutting edge and perhaps 0.25 in. up to allow for grinding. In this way you may carry a good hard cutting temper.

Vancouver, B. C. S. H. COOKE

Gages One-Half Bearing to Obtain Diameter

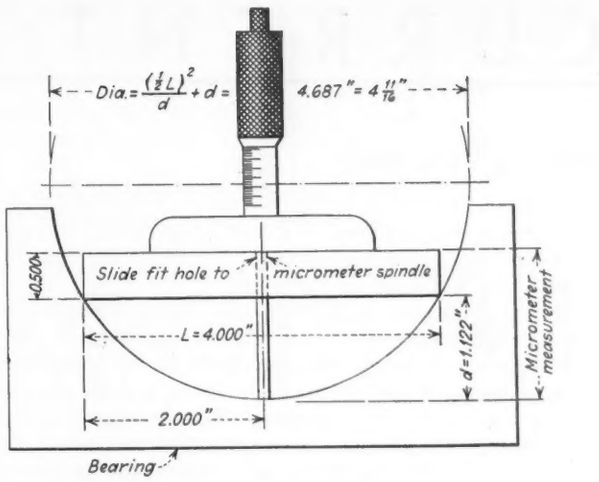
WHEN it becomes necessary to obtain the exact diameter of the bore of a bearing-half, the center of which lies beyond the measurable part of the bore, the device shown in the diagram, which I designed, is quite convenient. It consists of a plate of known dimensions with a hole for the spindle of a depth micrometer in its middle.

The device is made of steel, hardened for best service, and finish ground to the dimensions shown. As designed it accurately determines diameters from about 4 to 6 in. Diameters over 6 in. can be closely approximated. It is, however, advisable to make another gage for the larger diameters with *L* 6 in. or longer. For smaller diameters make *L* shorter so it enters the bore-half to be measured.

To use the device, place it in the bearing as shown in the figure. Adjust the depth micrometer until its spindle just touches the bore. Take the reading to the third decimal place. Subtract the thickness of the gage from the reading, obtaining *d*. Then the diameter may be determined by the formula:

$$D = \frac{(\frac{1}{2}L)^2}{d} + d$$

For example, reading obtained with the depth micrometer equals 1.622 in. Then 1.622 — 0.500 (thickness of gage) = 1.122. The *L* factor remains constant and equals 4.000 in. for this gage.



Then diameter $= \frac{4.000}{1.122} + 1.122 = 4.687$ in. $= 4\frac{11}{16}$ in.

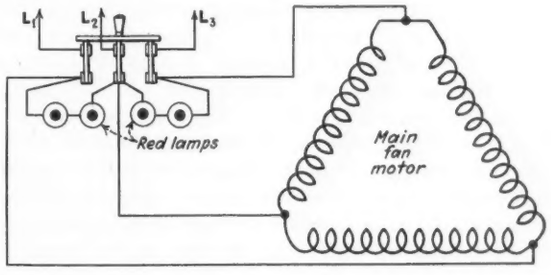
This is the diameter of the bearing bore.

Highland Park, Mich. PAUL C. BRUHT.

Red Light Warns When Fan is Shut Down

IN OUR PLANT wood-working refuse is burned under one of the boilers. This refuse is collected from several machines by a number of blowers and delivered through several pipes into a main pipe leading into the boiler room. In this large pipe is a fan that must be in service when the others are running to take the refuse from the main pipe and deliver it to the boiler.

On two or three occasions the main fan motor stopped and the stoppage was not discovered until the other fans had clogged the main pipe with refuse. In each case it was a considerable job to clean out the pipe before the fan could be started. The proper thing to have done would have been to interlock the motor controls so that



the auxiliary fan motors could not be started until the main motor was running.

Money was not available for such interlocks, so red lamps were used to indicate when power was on the motor main-fan terminals. The motor operated on 220 volts, and two 110-volt, 10-watt red lamps were connected in series across each pair of motor leads, as in the diagram. These lamps were in the fire room where they would easily be seen by the firemen. If they went dark when the plant was in service, it was a case of hustle and shut down the other fans.

Buffalo, N. Y. A. C. ARNOLD.

CURRENT COMMENT

Reducing Valve Noise

ANSWERS to the noise caused by steam reducing valves appearing in the July issue of *Power* are all partly correct. No mention, however, is made of the increased velocity of the steam at the reduced pressure.

To cite an instance which has come to my attention: A 2-in. valve, reducing steam from 100 lb. gage to 1½-lb. gage will under these conditions pass 3,000 lb. of steam per hour. This reducing valve is served by a 2-in. pipe in which the steam velocity is about 6,000 ft. per min. The outlet of this valve and about 6 ft. of outlet pipe is 2 in. to where it connects to an 8-in. line. Due to the increased volume of steam at the reduced pressure, the velocity of the steam in the 2-in. outlet pipe is not less than 18,000 ft. per min., hence causes much of the noise.

If the outlet from the 2-in. valve were 8 in., the velocity would be greatly reduced and the noise in proportion. Twenty-five years or more ago many reducing valves built for these extreme pressure reductions were provided with large outlets, some valves with a 3-in. inlet having at least a 10-in. outlet. Such valves were uniformly quiet in operation.

Cleveland, Ohio. CHARLES A. GREEN

Some Observations on Paint

THE article "Painting—What You Should Know About It," in the April and May numbers of *Power,* prompts me to offer the following facts, referring particularly to standard lead pigment paints.

No paint yet devised by man forms a chemical union with the surface on which it is applied. It sticks by adhesion and nothing else. This means that paint will stick to a rough surface better than it will to a smooth one. A clean surface, however, is essential. When paint is applied on a dirty, greasy or wet surface it has little or no chance to form a firm bond because there is something between the paint and the surface to which it is expected to stick. The binding and elastic qualities of all paints are furnished by the vehicle and not the pigment. When the vehicle is properly formulated it will conform to the irregularities of the surface on which the paint is applied. The color retention of pigments is also influenced by the composition of the vehicle. Yellowing of paints indoors is due to insufficient daylight. Again it is the vehicle which is affected and not the pigment. Claims for penetrative ability are based on the use of petroleum thinners in the paint.

In making paint no pigment should be used which will either form water-soluble compounds or promote chemical action within the dried paint film. Only opaque pigments should be selected which will give hardness and toughness to the dried film and protect it from destructive influences. Inerts should not be used because they are transparent and hence open up the film to light. Their presence enables the sun to destroy the vehicle prematurely.

There are available today many different kinds of paint varying in price, consistency, chemical composition and durability, frequently sold under proprietary names. Many virtues are claimed for them, which in some cases are justified and in others are at least too optimistic. In very many cases the composition of the paint is not stated, and there is always an element of risk in using any material of unknown composition. In perfect good faith such paints are sometimes specified and used on surfaces for which they are quite unsuitable, or under conditions which debar them from any reasonable chance of success. Disputes sometimes arise as to who is responsible for the unsatisfactory results, and friction ensues between the property owner, the engineer and the painting contractor, often involving heavy financial losses, without any one party being satisfied or convinced.

It must be evident that, if the composition of a paint is unknown to the user, its suitability for a particular purpose cannot be accurately judged, nor can the painter know what adjustment or special preparation of the surface, if any, are required to make its application successful. In such circumstances the natural and justified inclination of those in charge of painting operations is to turn to materials of which the composition and proportions are known and those which have stood the test of time.

The principal characteristics of white lead as a pigment are that, when mixed with linseed oil and dried in a paint film, it enters into chemical combination, forming a lead soap which has the effect of making the resulting paint film elastic, so enabling it to expand and contract with changes in temperature in unison with the surface to which it has been applied. The consequent waterproof character of a white-lead paint film is one of its most important characteristics.

A collection of dirt and soot on the surface of a white-lead paint film is frequently mistaken for discoloration of the white lead. It is true that in some circumstances white-lead paint may become discolored by the presence of hydrogen sulphide gas. The lead sulphide (black) which forms under such circumstances, soon takes up oxygen from the air and becomes lead sulphate which is white in color. The presence of sulphur dioxide may form lead sulphite, which is also white in color, and hence no discoloration takes place. White-lead paints, even when affected by sulphide gases, do not in any degree lose their protective power, and the film remains intact. In the case of paints made from some other pigments, the whole film is frequently disintegrated. Lead sulphate and lead sulphite are insoluble in water, in contrast with water-soluble products formed from certain of its substitutes. A drop of peroxide of hydrogen placed on the surface of a white-lead paint film will indicate whether or not the discoloration is due to the presence of hydrogen sulphide gas. If the film immediately bleaches white, it is sulphur discoloration. If no change takes place, it is dirt discoloration.

Flat white paints give the most visibility indoors because they diffuse light and do not reflect it. Paints with a metallic lustre may be practically invisible when the angle of incidence gets up to about 20 degrees. At certain other angles they produce shiners and shadows.

Just as good foundations are required as in actual building, so the quality of the priming determines not only the appearance of the finished work but also its durability. Durability is obtained by having a proper relationship be-

tween the pigment and the oil. In a priming coat the pigment should occupy about 30 per cent (by volume) of the dried paint film. This means that a gallon of red-lead paint should contain at least 20 lb. of dry red-lead. For a durable chromate primer it means about 15½ lb. of basic lead chromate in a gallon of paint, notwithstanding the fact that there are on the market chromate primers which contain only 1 or 2 lb. of lead chromate. In reality they are iron oxide paints to which a very small amount of lead chromate has been added for a sales talking point. Iron oxide pigments, by the way, possess great spreading power and opacity and paints made from them are cheaper than red-lead paints. They are, however, variable in quality and apt to contain basic sulphates of iron which act as carriers of oxygen to metallic surfaces and so promote corrosion, which it is their only object to prevent. Red-lead, on the other hand, is a very dense pigment, and the paint made from it dries with a hard and impervious film which is practcally waterproof and hence keeps out the weather to an unusual degree. When used on under-water surfaces, however, it is desirable to add some litharge to the paint just prior to its application to increase the hardness of the film and thus prevent water softening.

Red-lead can now be mixed with synthetic resin varnish. Such a mixture will dry to the touch within an hour and can be coated over successfully within four hours. It is thus possible to put on two coats in one day.

Care should be exercised in the use of coal tar paints. They frequently contain tarry acids which attack the metal under the coating and cause rust. Asphalt paints exposed to the sun become brittle and are soon destroyed.

New York, N. Y. FRANCIS M. HARTLEY, JR., M.E.
National Lead Co.

Steel Drum Problem

IN REGARD to Mr. Woods' steam experiment as stated in the August number: It would be impossible to give even an approximation of the pressure in the barrel without knowing the diameter of the head, the thickness and tensile strength of the metal, the strength of the joint connecting the head with the drum, and if dished, the amount and direction of same. The fact that the head blew out indicates that the joint or the metal near the joint was the weakest part of the barrel. Possibly the makers of the barrel know the bursting pressure.

As Mr. Woods says he is very much interested, I would suggest that he try the experiment over again on another barrel. But this time he should dig in or construct some kind of a bomb proof where he could locate a high-pressure steam gage not over 100 ft. from the barrel. Advantage should be taken of any natural protection, such as a large tree or rock for safety. The gage should be securely fastened to a stout post set in the ground and in such a way that it will not be damaged when the pipe is broken by the explosion. The pipe should not be less than ⅜ in. in size and should slope from the barrel to the gage. It should be filled with water for its entire length before it is connected.

Seattle, Wash. ALFRED KENNEDY.

FROM the description of the rather unsafe experiment described on page 465 in the August number of *Power*, the bursting pressure of the oil drum may be estimated from the formula $P = \frac{4STE}{D}$, where P = the bursting pressure in pounds per square inch, 4 = a constant for bursting of a cylindrical vessel at a circumferential seam in a longitudinal direction. S = the tensile strength of the metal which will be taken as 50,000 lb. per sq.in. T = thickness in inches = 3/32 in. E = efficiency of the circumferential seam in relation to strength of solid plate. This will be taken as 70 per cent for the estimated strength of a pressed and flanged seam. D = the diameter of the vessel in inches—22 in.

$$P = \frac{4 \times 50{,}000 \times .094 \times .70}{22} = 597 \text{ lb. per sq.in.}$$

This pressure is only approximate and is based on the assumption that failure took place at the head seam.

A cylindrical vessel will usually fail along a longitudinal axis, but the steel drum is usually strengthened in this direction by steel ribs or flanged construction which more than double the strength.

Mr. Woods does not give the diameter of his boiler, but it is assumed to be 60 in. The formula for figuring the bursting pressure is $P = \frac{S \times T \times E}{R}$. P = the bursting pressure of the boiler shell. S = the tensile strength of the metal which for steel will be taken as 55,000 lb. per sq.in. T = the thickness of the shell plates = ⅜ in. E = the efficiency of the longitudinal seam. R = radius of the shell. The boiler described is undoubtedly of the horizontal return tubular type, over 20 years old and of double-riveted lap construction along the longitudinal seam. The efficiency of such a joint is about 70 per cent.

$$P = \frac{55{,}000 \times 0.375 \times 0.70}{30} = 481.2 \text{ lb. per sq.in.}$$

With a factor of safety of 5, a maximum allowable working pressure of 96.6 lb. is obtained. Some codes use a factor of safety of 8 when a lap-riveted boiler drum exposed to the fire is over 36 in. in diameter and over 20 years old. This would give a maximum safe working pressure of 60.2 lb. for this size boiler. With such a boiler of this age the bursting pressure might be assumed to be as low as perhaps 301 lb. due to reduction in thickness of the shell plates through corrosion and erosion.

Brookline, Mass. HARRY M. SPRING.

Oil Vapor from Two-cycle Diesel Crankcases

OUR engine room was bothered with an oily vapor issuing from the crankcases of our two-cycle diesels. This caused bad air in the engine room, and oil would settle on the engines and walls of the plant. Oil was also drawn into the generators, making a mess at cleaning time. This trouble was overcome by piping from the crankcase breather to the air suction line. The engines are of the type in which the bottom of the cylinder is closed off from the crankcase and the lower part of cylinder is used for the scavenging air compressor. A 2-in. pipe was welded to the breather of the case and the pipe reduced to ½ in. where it is connected with the air suction. Due to the suction of the air line, a slight vacuum is formed in the crankcase.

We had trouble with oil leaks from the joints of the case and with oil passing the packing on the piston rod. This vacuum in the case has stopped the oil leaks and also stops the oil from passing the rod packing.

Our cost for the change was about ten dollars per engine. Our oil saving alone is about 2 gal. per 24 hr.

Walthill, Neb. WM. W. DINGWALL.

READERS' PROBLEMS

QUESTIONS for Our Readers

What Are Steam Rates?

Question 1

AT PRESENT *we buy all power, but we are considering installing a generating unit to produce part of our power load from process steam. A steam pressure of 125 lb. can be carried on our present boilers. The management is unwilling to buy new boilers for higher pressure at the present time. No superheaters are installed, but they can be if they would pay for themselves in three or four years. Five pounds pressure is ample for process and heating. At no time ordinarily will the process steam produce our full power load—the balance will be purchased as at present.*

We have prepared approximate load curves for steam and power demands and would like some data on the steam consumption of engine and turbine sets of about 200 kw. capacity, both with and without superheat (say 100 deg.), at full load and half load. About what would be the steam rate per kw.-hr. of the following units:

Steam turbine—average
Steam turbine—high efficiency unit
Good corliss engine
Good uniflow engine.

Can your readers give us this information, based on their actual operating experience over a period of years, with some or all of these machines? Which types fall off fastest in efficiency with use, and about how much? What about their relative costs installed? Any other practical advantages or disadvantages which should be considered in selecting a generating unit?

—W. W. D.

Straightening Diesel Crankshafts

Question 2

WE ARE *encountering a number of new problems in overhauling our many types of diesels, ranging from 1-cyl. horizontals to many-cylindered verticals. We have always "miked" crankshafts in order to test and correct alignment, but we have recently come to the conclusion that our former procedure is not adequate. Dial gage readings taken on the journals of many shafts have shown that many are bent to some extent, and regardless of main bearing level cannot hope to run true. We therefore must develop some more accurate procedure for checking and straightening crankshafts. What procedure can we use and how can we interpret our findings? Is the so-called "hot spot" method of value? If so, who invented it and where and with what success has it been used? Is the resulting shaft permanently corrected? What is the theory and technique. Is the data secured by dial gage readings plottable to permit mathematical or graphical analysis in order to locate points of maximum deflection?*

—E. R. O.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Gas Engine Vibration

ONE OF *our subsidiaries is a gas-engine driven plant containing two 250-hp. gas engines. The engines are not noisy and do not produce perceptible floor vibration through their isolation. Recently a neighboring property owner has been complaining that our engines are causing the screens on his building to vibrate. This appeared to be such a minor complaint that we disregarded it, but now he threatens legal action and it is essential that we take steps to remedy the condition. How can we go about it?* —C. G. S.

Obviously, the quickest thing to do is to provide wedges for your neighbor's screens or to change their period of vibration. But if your engines are causing the trouble, it may crop up somewhere else, so that a bit of engineering analysis won't go amiss.

In the absence of any specific data regarding your plant or its location, this answer must take into account a number of possibilities. You say your exhaust lines are not noisy, but the possibilities still are good that exhaust pulsation is causing the trouble. Very likely the vibration period of the screens is the same as that of the exhaust pulsation, or a multiple of it, thus making the screens vibrate in sympathy with the exhaust. This seems particularly plausible, because apparently only the screens are vibrating. The pulsation may be so slow that it is below the threshold of sound—less than 16 per second—where the impulse is no longer audible but may still set up distinct pressure waves about the end of the exhaust pipe. A 32-ft. organ pipe, for example, begins to make a distinct rap rather than a continuous note. Changing exhaust pipe length is the easiest solution if this is the case. It is possible also that the exhaust pipe just happens to be of harmonic length, the impulses following each other at such intervals that the new pressure wave strengthens the secondary impulse of the previous wave. Test this by putting a nozzle or bell mouth at the end of the exhaust pipe. Either will change the conditions, one lengthening the impulse, the other relieving the pressure before the wave hits the open air. Still another thing would be to cut several holes along the pipe at various distances from the engine exhaust header and insert in these holes short lengths of 2-in. or 3-in. pipe with rubber diaphragms at their outer ends. These will change the "pitch" of the exhaust pipe and will have the same effect as changing the pitch of a fife by covering fewer or more holes. Lastly, the length of the exhaust pipe can be altered in increments of several feet or a silencer can be fitted.

Another possibility is that the exhaust pipe itself is vibrating, this vibration being transmitted to the power plant building or to the ground and being carried through the ground to your neighbor's building. This can be corrected by hanging the exhaust in isolating spring mountings or some similar treatment.

Another possibility is that the engine, even though vibration-isolated, is creating enough noise so that the building wall (particularly if of sheet metal) is acting as a drumhead and in this way creating either atmospheric or ground vibration which is finding its way to the screens. This can be corrected by using sound-isolating material on the engine-room walls.

The last possibility is that the isolation may be faulty and the vibration of the engine is being carried to the ground, even possibly to a subterranean watercourse or a particular rock stratum which is transmitting it to the building in question. But such a vibration should be felt in the engine room itself unless it is communicated to the underground stratum by a pipe or foundation element free of the engine-room floor.

Some of these conditions and corrections have occurred in other plants, others are largely conjecture and may not work in actual practice. In any case, they are simple and inexpensive to try. Solution of a problem like this may be exceedingly difficult or again absurdly simple. All anyone can do is try, unless he is one of the few experts in problems of sound. Other means failing, there are several good isolation consultants available. Possibly the answers on page 467 of the August number of *Power* may suggest something else.

CONSTANT STEAM PRESSURE WHERE?

ANSWERS to August Question 1

THE QUESTION

WE HAVE *three pulverized-fuel-fired boilers which supply steam at about 250 lb. pressure and 650 deg. to our turbine room. The boilers are operated to maintain drum pressure as nearly constant as possible, and only enough below the safety valve setting to prevent popping off on sudden load decrease. This of course means that the pressure in the steam header varies with the boiler output, because of the pressure drop in the superheater and piping. Other plants, we understand, operate to maintain constant pressure in the steam header. What,*

if any, is the advantage of this latter method of operation? Will either method influence turbine-room performance?

Maintain Throttle Pressure High as Possible

THERE is no advantage in maintaining constant throttle pressure. Steam pressure at the turbine throttle should be maintained as high as possible because of the increased economy in the turbine room.

A typical curve on a Curtis steam turbine gives a decrease of 4 per cent in the water rate when the throttle pressure is increased 50 lb.

If, with dry steam at 250 lb. pressure and 28 in. vacuum, the steam consumption be equal to 1.0, at 300 lb. pressure it becomes an average equal to 0.96 (a decrease in steam consumption of 4 per cent). Taking theoretical figures for convenience, and assuming that the condensed water from the condenser is used as boiler feed, and its temperature is equivalent to a vacuum of 28 in. (101 deg. F.) it will require 1,273 B.t.u. to evaporate 1 lb. of this feed at 250 lb. and raise it to superheated steam at 650 deg. F. In order to raise the same feedwater to 650 deg. steam at 300 lb. pressure it will require 1,271 units of heat—a decrease of 2 British Thermal Units, i.e., a decrease of 0.16 per cent.

Therefore, the heat consumption is decreased 0.16 per cent due to less heat units being put into the steam and 4 per cent due to higher pressure, so the heat consumption is decreased 4.16 per cent by raising the throttle pressure from 250 lb. to 300 lb.

Practically speaking, for maximum economy and safety the superheater safety valve should be set high enough above maximum allowable throttle pressure to care for line drop at minimum load. In making this setting, however, it must be remembered that the superheater safety valve must pop before the boiler drum valves at any load.

Buzzard Point, Washington, D. C. C. E. MILLER

Best Operation Is At Variable Drum Pressure

IT WOULD appear to me that A.A.F. is not operating his plant to the best advantage. To demonstrate this, I have assumed certain pressure drops through the superheater and piping to the turbine at full load and at a very light load, as shown in the tabulation.

Superheater safety valves should be set to blow before the drum safety valves in order that steam will flow through the superheater tubes in case of a shutdown and so protect them from injury. Since A.A.F. is supplying steam to his turbine at 250 lb. his superheater safety valves are set to blow at slightly above this pressure. At light loads then, his drum pressure would be not over 255 lb. pressure. As he operates at constant drum pressure, at full load, the pressure at the superheater outlet drops to 225 lb. and at the throttle the pressure is only 210 lb.

If, however, he were to operate with a variable drum pressure, maintaining the pressure at the superheater outlet, constant at 250 lb., the throttle pressure at full load would be 235 lb. instead of 210 lb. pressure.

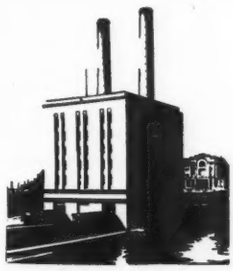
The steam rate of a turbine decreases about 1 per cent for each 10-lb. increase in pressure, so that by allowing the drum pressure to vary and keeping the superheater outlet pressure at 250-lb. turbine room performance at full load would be improved by 2.5 per cent—a worthwhile saving, especially as it costs nothing.

Binghamton, N. Y. R. P. BROCKNER

	Drum pressure constant		Header pressure constant	
	Full load	Light load	Full load	Light load
Drum pressure	255	255	280	255
Drop through superheater	30	5	30	5
Superheater outlet pressure	225	250	250	250
Drop through piping	15	3	15	3
Throttle pressure	210	247	235	247

Superheater Safety Valve Setting Controls Header Pressure

SUPERHEATERS operating in this temperature range, 650 deg. F., should be given some protection from overheating in case of sudden load drop. This is accomplished, in most cases, by setting the superheater safety valve to operate at a considerably lower pressure than the



safety valves on the steam drum. Thus the superheater safety valve, rather than the safety valves on the steam drum, governs the maximum pressure of the header.

When operating under these conditions, the drum pressure may be increased as the load is increased, and at maximum steam flow may be considerably above the popping point of the superheater safety valve. As the greater part of the pressure drop between the drum and throttle is through the superheater, the result is that nearly constant pressure is maintained on the header.

The advantage of this method of operation is that thermal efficiency is maintained, or possibly increased in some cases, during peak loads when most needed.

In this particular case, however, where maximum drum pressure is carried at all times, there can be no advantage from the standpoint of thermal efficiency, in lowering the operating pressure at lighter loads to conform with that of peak-load operation.

South Amboy, N. J. RAYMOND SEPTOR

Operation With Constant Drum Pressure Best

IN THE particular case of A.A.F. I would say that his present method of pressure control is satisfactory. At peak loads it may be assumed that there is a 40-lb. pressure differential across the superheating system. This would give a header pressure of about 205 lb. When the load drops to one-half rated capacity the header pressure will rise to say 225 lb., assuming the combustion control system to be operated from boiler pressure.

Now if the combustion control is operated to maintain constant header pressure and allow the boiler pressure to swing with load fluctuations, the highest header pressure which could be constantly carried without having the safety valves pop at each drop in the load would be 205 lb. It is probable that fractional loads will be carried part of the time. With these fractional loads the turbine will, by the former method of pressure control, operate with a lower steam rate due to the increase in header and throttle pressure. This gain is about 1 per cent for each 10-lb. increase in throttle pressure. An added advantage of maintaining constant boiler pressure is that the water level in the boiler will be more stable with fluctuating loads.

Brookline, Mass. HARRY M. SPRING

HOW TO MINIMIZE STEAM FLOW PULSATION

ANSWERS to August Question 2

THE QUESTION

WE ARE *considering installation of a 300-kw. engine in our factory, to be operated on 150-lb. steam purchased from a neighboring plant about 100 ft. away. Steam is to be paid for at a certain rate, per 1,000 lb. but we understand that all flow meters will read high because of the pulsating flow caused by the steam engine. What can be done to minimize this error? Will installation of an oversize steam line or receiver help?* G. R. R.

Use Orifice To Reduce Pulsation

TO REDUCE the error caused by pulsating flow the pulsations must be reduced to a point at which they do not seriously affect metering. This may be done by using a throttling orifice, receiver, or both. An oversize steam line would help by acting as a receiver to a limited extent. The throttling orifice is to be placed in the steam line between the measuring orifice and the engine, and it is made the same size or slightly

smaller than the measuring orifice. If a receiver is used, it is placed between the engine and the throttling orifice.

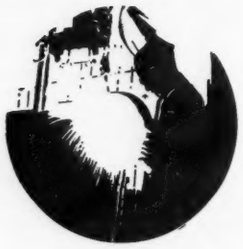
Metering will generally be satisfactory when pulsations are reduced so that the total oscillation does not exceed about 6 per cent of the static pressure. The amplitude of the pulsations may be indicated by the oscillation of an undamped manometer or pressure gage, since pressure pulsations always accompany flow pulsations.

A problem of this kind should really be taken up with the makers of the flow meter to obtain the location of the throttling orifice, and the size of the receiver, also each maker has his own specific method of dealing with flow problems of this kind. If possible a test should be run covering as wide a range of operating conditions as possible, in which the steam to the engine is condensed and weighed, and the results compared with the steam recorded by the flow meter. If the two results do not check, a correction factor can be derived for correcting the steam shown by the flow meter.

Leavenworth, Kan. HARRY CANTRELL

Use of Large Pipe Not Economical

THE FLOW meter in the line to G.R.R.'s engine can be made to read correctly by installing a receiver on the engine side of the meter. The engine in question, running at say 200 r.p.m. and taking 6,000 lb. steam per hour at full load, would take about ¾ lb. of steam per power stroke. A well insulated tank capable of holding 25 lb. of steam would



smooth out the pulsations entirely. The receiver method of reducing the pulsations would be more economical than using a larger pipe between plants because a larger pipe would cause a considerably larger radiation loss. This loss would probably cost more than the loss inflicted by the flow-meter reading high due to pulsations. Since G.R.R. is paying for steam at the pound rate and not the heat rate he had better conserve the heat units; hence the practical method seems to be to install the receiver rather than larger pipe.

Westfield, N. J. GORDON R. HAHN

Pulsations Make Meter Inaccurate

STEAM flow meters are not accurate for measurement of pulsating flow. Installation of a large receiver at the engine and placing of the flow meter as far from the engine as possible will help. The effect of friction on the flow between the meter and receiver and the storage effect of the receiver will cause flow through the meter to be more steady and its indications more nearly accurate. As a further check, actual weighing of the condensate should be done at different engine loads to get a calibration of the meter.

Corvallis, Ore. WALLACE H. MARTIN

Receiver Evens Out Pulsations

IT IS true that a flow meter will read too high if connected in the conventional manner to measure a fluctuating flow. The flow recorder will give a reading proportional to the square root of the average head differential instead of the average flow. Where the average flow is 50 per cent of the maximum, the average quantity shown by a meter would be 70.7 per cent. By determination and use of the pulsation factor, present-day flow meters may be used to measure pulsating flow.

A more convenient method, however, is to reduce the pulsations to a minimum. Although the installation of an oversize steam line would help, I believe that this is an unnecessary expense. Let's assume that the engine operates with a steam rate of 30 lb. per kw.-hr. Then at full load there will be a demand for 9,000 lb. of steam per hr. Assuming a speed of 150 r.p.m., each revolution of the engine will require approximately 1 lb. of steam. Allowing a receiver displacement sufficient to supply two revolutions, 5½ cu.ft. will be required. A tank 2 ft. long by 22 in. in diameter will have this capacity. This tank should be located close to the engine and it is important that it be properly trapped to prevent any accumulation of water.

Brookline, Mass. HARRY M. SPRING

THE ENGINEER'S BOOKSHELF

Heat Power Engineering

ELEMENTS OF HEAT POWER ENGINEERING, (3RD EDITION) PART II, STEAM GENERATION AND PRIME MOVERS; PART III AUXILIARY EQUIPMENT, PLANT ENSEMBLE, AIR CONDITIONING AND REFRIGERATION. *By W. N. Barnard, Frank O. Ellenwood, Clarence F. Hirschfeld. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. 8x9 in., cloth, illustrated. Part II, 871 pages. Price $5.00. Part III, 420 pages. Price $4.50.*

Publication of Parts II and III of "Heat Power Engineering" completes what is undoubtedly the most up-to-date and complete text on this subject. Part I published in 1926, dealt with thermodynamics, while these two volumes are concerned more with the equipment of power engineering. Although a third edition, it is practically a new book, so extensively has it been rewritten, added to and brought up-to-date, both as regards text and illustration.

Part II contains 21 chapters. The first five are concerned with the steam engine and turbine. The treatment of turbines is unusually complete for a general power text and covers nozzle characteristics, blading, turbine losses, operation, types of units and governing. Steam engine valve diagrams and valve gears are fully discussed.

In the chapter devoted to heat transmission, the discussion of heat transfer by radiation is unusually complete. Mean temperature difference is well treated and a chart given for finding the logarithmic mean temperature difference. Economics of heat insulation is also treated.

Eleven chapters are devoted to the general subject of combustion. Classification of coals, the physical characteristics of coal, oil, alcohol, gas and wood are treated in a chapter on Fuels. General principles of combustion, analysis of flue gas and its interpretation, and fundamentals of steam-generating units are covered in three chapters. Burning of coal on stokers, burning pulverized coal, burning gas, oil, by-product fuels, combustion control and furnaces are each treated in separate chapters. The chapters on stokers, pulverized coal and gas firing are very complete, but oil firing seems to be treated less fully than its importance warrants.

The last three chapters deal with boilers, superheaters, reheaters, desuperheaters, economizers and air preheaters. These chapters contain cross-sections of many of the most modern boiler units installed.

Part II contains eleven chapters dealing with flow of fluids, draft systems, condensers, feed-water heaters and pumps, feed-water conditioning, properties of air water vapor mixtures, cooling towers, power plant ensemble, heating, ventilating and air conditioning and refrigeration.

The chapter on fluid flow is primarily concerned with resistance to flow of fluids in pipes and gives considerable data for finding friction coefficients for various Reynolds numbers. Particularly noteworthy is a chart showing the kinematic viscosity of steam up to temperature of 1,000 deg. F. and 1,400 lb. pressure. This chapter also discusses steam plant piping.

Considerable space is given to the discussion of surface condensers and cross-sections of modern units are shown together with present-day condenser design ratios and performance data. Economics of condenser size, arrangement and operation is also given.

Some information on pumps is given both in the chapter on condensers and in the

chapters on feedwater heaters. In neither instance, however, are any pump performance curves given nor any explanation of the principles of operation or characteristics of centrifugal pumps. This very important power-plant equipment should have been treated more fully.

Some very good power plant cost data is given in the chapter on plant ensemble. The chapter on refrigeration gives a general description of mechanical refrigeration equipment, describes the absorption system, steam-jet vacuum refrigeration, and several household refrigerators.

Hydraulics

APPLIED HYDRAULICS (1934)—*By Herbert Addison, Prof. at the Royal School of Engineering, Giza, Egypt. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. Clothboard covers. 320 illustrations; 409 pages, 6x8½ in. Price, $5.50.*

As a work on hydraulics, this book has some unusual features. It presents a compact summary of fundamental principles of hydraulics and the manner in which they are applied by engineers. The author has kept in mind readers whose work is not directly connected with the art, but who must keep in touch with practical hydraulics, for example electrical engineers, who must be familiar with performance rather than mechanical design details of pumps and turbines, with which the electrical machines are closely associated.

The book is divided into two parts, so that when used as a reference only the second part, dealing with practical applications, need be consulted. The first part of the book, in six chapters, deals with fundamentals of hydraulics, such as liquids and their properties, static pressure of liquids and the flow of liquids under various conditions. The second part includes pipes and piping systems, control of water in open channels, automatic-control devices, hydraulic turbines, pumping machinery, hydraulic transmission and storage of energy, and hydraulic measurements. Sixty-eight pages are devoted to problems in hydraulics, many of which are worked out to illustrate methods of dealing with such problems.

Lab Practice

MECHANICAL ENGINEERING LABORATORY PRACTICE (2ND EDITION)—*By Charles F. Shoop, prof. of steam engrg., Univ. of Minn., and Geo. L. Tuve, associate prof. of mech. engrg., Case School of Applied Science. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. 477 pages, 6x9 in., 192 illustrations, 33 tables. Clothboard covers. Indexed. Price, $4.00*

Originally published under the above title, the new edition is published under the title, "Mechanical Engineering Practice—A Laboratory Reference Text." Essentially a textbook of experimental engineering, this work is also a reference work for use from the beginning of college laboratory work through after-graduation experimental practice. Hence the change of title.

Sixteen experimental projects have been added, mainly in heating, air conditioning and internal-combustion engines. Extensive additions have also been made to the chapters on Mechanical Measurements. Heat Transfer and Fluid Flow Measurement. Several reference tables have also been added, all without increasing the size of the book, simply by reducing type size. The book is easily readable, however, and illustrations are large and distinct.

Smoke

SMOKE AND THE ATMOSPHERE (1933)—*By J. R. Ashworth, D. Sc. Published by Manchester University Press, 23 Lime Grove, Oxford Road, Manchester, 15, England. 131 pages, 5½ x 8½ in. Indexed. 5 appendixes, references, notes. 31 illustrations and many tables. Clothboard covers. Price 7/6 net.*

Regular study of the smoke problem in a given locality and careful analysis of the results has almost unmeasurable practical value in smoke control. This book comprises chiefly the results of investigations upon impurities in the air of an English factory town (Rochdale near Manchester) begun many years ago, and carried on constantly since 1916. The subject is approached scientifically to provide some knowledge of the amount and distribution of atmospheric pollution, particularly in its relation to meteorological elements. Special instruments had to be devised when the studies were started. These are described, and data collected and carefully tabulated. Important data are given on transportation of impurities, effect on visible light and ultra-violet rays, influence of smoke and hot gases, etc.

BRIEF REVIEWS

TURBINES, 1934. *Publication No. B4 of the Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price, 40 cents to members and $1 to non-members.*—This is a report of the Turbines, Auxiliaries and Piping Sub-committee of the Prime Movers Committee, and includes 1933 operating records for 310 large turbines and for 15 turbines operating above 1,000-lb. steam pressure. It includes a general statement on turbine oil piping and on non-inflammable fluids for turbine control systems, experiences with blade erosion, procedure for laying up turbo-generators, miscellaneous turbine troubles, and manufacturers' statements covering latest developments.

EYE PROTECTION IN INDUSTRY. *Published by the National Society for the Prevention of Blindness, Inc., 450 Seventh Ave., New York, N. Y. Publication 77. Price, 5 cents.*—This article, by Louis Resnick, director of industrial relations of the Society, has been reprinted and includes a self-appraisal for safety engineers.

NEUERE ENTWICKELUNG DES DAMPFKESSELBAUES (RECENT DEVELOPMENTS IN THE CONSTRUCTION OF STEAM BOILERS). *By Ernst Lupberger. Published by Verlag Stahleisen, Düsseldorf. 26 pages, 28 illustrations. Price 3.90 reichsmarks.*—Remarkable progress has resulted from the efforts of designers of steam boilers to avail themselves of the results of scientific research, replacing more empirical methods of former times. These researches cover a great variety of topics which the author reviews. The process of steaming has been investigated by means of motion pictures, and equations of heat transfer have been deduced, of exponential form. Studies of steam and water flow, of the movement of steam bubbles relative to the water, and of the process of combustion have influenced the design of super-heaters, made possible the reconstruction of existing boilers for increased output, and influenced the design of combustion chambers and passages. Tensile tests at high temperatures have been made to show the properties of special alloys. A table is reproduced in the article. Several pages are devoted to the construction of recent large boilers and furnaces and data are given on 17 German installations and 14 in the United States. The paper closes with a discussion of chemical problems. In his resume of present trends, the author considers especially the possibilities of power units comprising a turbine and its associated boiler or boilers. The paper is a reprint of a series of articles that appeared originally in the publication, "Stahl und Eisen."

DIE SCHWEIZERISCHE MASCHINEN- UND ELEKTROINDUSTRIE (THE SWISS MACHINE AND ELECTRICAL INDUSTRY)—By Dr. B. Lincke. This is an 88-page, 8½x12-in. clothboard covered volume for the semi-centennial of the Society of Swiss Machine Industrialists, published by Orell Fussli Verlag, Zurich, Switzerland. A review of the 50 years, both from the general social and political angle, and from the angle of the organization itself.

OIL AND GAS ENGINES, 1933-1934. *Publication No. B7 of the Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price, 40 cents to members and $1 to non-members.*—This report of the Oil and Gas Engine Sub-committee of the Prime Movers Committee, summarizes new developments and installations in the United States, discusses accessories and auxiliary equipment, considerations in plant design and operation, water and lubricating oil cooling systems, equal fuel oil, operating troubles, trend of operating costs, and plant operating data on 52 engine units.

INVESTIGATION OF WARM-AIR FURNACES AND HEATING SYSTEMS, PART VI. *By Alonzo P. Kratz and Seichi Konzo. Published as Bulletin No. 266 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. 128 pp., 6x9 in. Paper covers. Price, $1*—This is a report of a series of tests which have shown that: In the case of uninsulated metal surfaces, transmitting heat to air, the nature of the metal and thickness of the wall, may bear little or no relation to the heat transfer. In the case of uninsulated metal surfaces, transmitting heat to air, the character of the surface finish is the major factor in determining the heat transferred, bright metal surfaces transmitting less heat than rust metal or painted surfaces. Thin layers of insulation placed on bright metal surfaces, transmitting heat to air, may result in increasing the heat transferred. Such surfaces should be covered with the equivalent of at least one-quarter inch of good insulation. Since asbestos paper has the same characteristics as plain asbestos paper when used as a heat insulator. Some copies free.

LUBRICATION and POWER GENERATION
FEATURE A.I.S.E.E. CONVENTION

How lubricating oil may be economically reclaimed—application of pressure-centralized lubrication systems—new developments in lubrication—power generation for industrial plants with diesel engines—and rehabilitation of old steam plants by superposing high-pressure, high-temperature steam units

WITH the Statler Hotel, Cleveland, Ohio, as headquarters, the Association of Iron & Steel Electrical Engineers held its 30th Annual Convention during the three days, Sept. 18 to 20. This convention was one of the most successful in the history of the Association, with a large attendance at all of the seven technical sessions. A feature was a trip to the Otis Steel Company's plant, when an opportunity was afforded to inspect a wide variety of modern steel- and iron-producing equipment.

The Iron and Steel Exposition was held in the Cleveland Public Auditorium simultaneously with the convention and under the auspices of the Association. More than 100 manufacturers of power and other equipment associated with iron and steel production occupied space in the exposition. Considering that this country is still feeling the effects of the depression, the exposition was highly successful. Most of the exhibits were extensive and arranged to give practical demonstrations of equipment performance, and attendance was large.

At the seven technical sessions, 27 papers and reports were presented, including such subjects as iron- and steel-mill practices, lubrications, bearing applications, mill drives, fuels, power generation, rehabilitation of power plants, automatic control and welding processes. Papers pertinent to power engineering are here summarized.

Oil Reconditioning

R. P. Dunmire described methods for servicing steam-turbine, diesel and transformer oils. When presenting his paper, Mr. Dunmire said that study of various electrical insulating oils shows definitely that their deterioration is caused by contamination which consists of free water, solids, and various types of sludge mostly soluble in these types of mineral hydrocarbon. Such sludges are caused to form due to the presence of oxygen in the oil, and are of three principal types: soap, asphaltic, and carbon. Analysis of such sludges shows an abundance of oxygen.

Suitable apparatus for removing such contaminants has been perfected and marketed, and definite operating data has been secured which shows marked improvement in operation both from a dielectric standpoint and a definite reduction in temperature of transformers.

Steam-Turbine Oils

Lubricating oils for turbines are usually contaminated by dust, rust, water accumulating from steam leaks, and various sludges. Acids are formed in heated turbine oil by a combination of oxygen from the air and act on the oil as extremely strong emulsifying agents. Sludges formed in turbine oils are also due to a reaction between oxygen and oil and act to form more sludges with increased temperature, and in the presence of catalyzers, such as copper and brass tubing in the oiling system.

Diesel engine oils are also contaminated by oxygen, and large quantities of carbon residue and water condense on the interior of the crankcase. Such oils can now be reclaimed economically, and the quality brought up to that of the original oil, in some cases even better.

This, of course, is all predicated on the fact that only best-grade oils be used initially. Such oils can be reclaimed any number of times and at a cost per gallon that is very economical.

Treatment for reclaiming and reconditioning such oils consists of removing all the light volatiles by means of a low-temperature vacuum treatment, then removing the polymerized compounds, resins, tars, waxes and acids by a simple absorption process which consists of intimately contacting the oil with Fuller's earth for a definite time and at a definite temperature, and then thoroughly filtering out the earth with its absorbed impurities. This operation, of course, removes soluble contaminants as well.

Tests on a steam turbine extending over a period of four years show that there is practically no increase in acidity of oil, and that the steam emulsion value of the oil remains practically constant.

When the oil is continuously vacuum-treated, diesel as well as turbine oil can be maintained in a condition comparable to that of new oil, and color can be restored economically.

It is fundamentally true that the economical reclamation of a lubricating or insulating oil depends largely on the quality of the original oil, as well as the refining process and equipment. The better the grade of oil initially, the greater the percentage of recovery and the corresponding decrease in costs of recovery and total lubricating costs.

Oils that have been poorly refined originally are unstable in virtually all of their characteristics, consequently, are expensive lubricants.

Centralized Lubrication

Progress of centralized lubrication in the steel industry was outlined by A. J. Jennings, who called attention to cases where savings obtained with centralized lubrication systems amounted to 10 times the cost of the system per year and bearing life had been increased twelve times. As part of the paper, Mr. Jennings described several of the various types of centralized lubrication systems available.

Proper lubrication, he said, is of vital importance to the steel industry, and no industry offers a greater opportunity for lower costs and higher operating efficiency by means of better lubrication.

Good lubrication not alone demands the use of the correct grade of lubricant, but also that this lubricant be properly applied by a dependable method and at regular intervals.

Intermittent lubrication by hand generally results in a feast or a famine for all bearings; some may be missed entirely. Wasted lubricants, increased friction, high power losses, frequent shut-downs for repairs and lost production always follow.

The use of a modern centralized system of lubrication combined with the correct grade of lubricant will avoid waste of lubricants, reduce friction, lower consumption of power, increase life of bearings, reduce repairs, increase production and provide complete safety.

Circulation of Oil

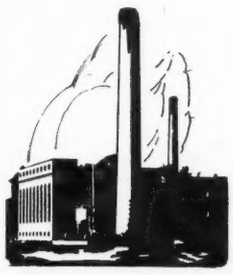
"Factors Affecting the Circulation of Oil" was the subject of a paper by Maurice Reswick, in which all the parts of a forced-feed, recirculation lubrication system, and the characteristics of lubricating oil were discussed. Attention was called to forced-feed lubrication as now being recognized as the most efficient method of bearing and gear lubrication in the steel industry. Steel-mill machinery of today is designed and built more and more along the lines of precision, accuracy, close tolerances and for continuous production. More efficient lubrication by means of circulating oiling systems had to be developed for the successful operation of modern machinery.

The closest approach to perfect lubrication is attained in forced-feed systems, which supply the wearing surfaces of bearings and gears with cool and clean oil from a central reservoir of ample

capacity. The function of a circulating system is not only to lubricate the parts of machinery in sliding or rolling contact, but also to carry away the heat from the friction surfaces, and avoid abnormal operating temperatures which might soften the babbitt in a bearing or draw the temper in ball or roller bearings.

Gear Lubrication

The correct lubrication of gear reduction units and pinions is a major problem in steel plants. On older installations a heavy pitch-like grease or gear-shielding compound was recommended for the gears and a comparatively light-viscosity mineral oil for the bearings. In spite of the great care given to isolate the gears from the bearings, contamination of lubricants takes place—the gear compound becoming gradually lighter and the bearing oil heavier in viscosity. The gear cases heat up on account of the churning of the excess lubricant in the case, while the operating temperature of the bear-



ings rises due to the greater friction with the thickened oil. The latest approved and preferred practice is to use the same lubricant on both gears and bearings, applied by means of a circulating system, delivering the oil to the bearings in a continuous stream and to the mesh line of the gears in a continuous spray.

New Developments

It is well known that some oil gives better lubrication than others. The answer to this, said G. W. Miller, in his paper, "New Developments in Lubrication," is the fact that one oil contains more "oiliness" than the other. "Oiliness" is defined as that property of lubricants by virtue of which one fluid gives lower coefficients of friction than another fluid of the same viscosity. "Oiliness" under practical operating conditions is of greater importance than is generally recognized.

It has been known for years that the least refined of petroleum oils, provided certain detrimental qualities are not too outstanding, are in general better lubricants than the same oils highly refined. It has become possible to manufacture from crude oils themselves, bodies which have the properties of those contained in the natural crudes, finally to add these bodies to the oils so that the "oiliness" lent to mixtures with petroleum oils is much beyond that which can be produced by any kind of refining.

With these natural crude oil bodies, friction under full-fluid-film lubrication can be reduced as much as 50 per cent, which means a tremendous saving in power consumption. At the same time, it is possible to lend to the oils the ability to resist film rupture even under pressures that go far beyond that of normal bearing design and construction. The same materials lower the surface tension of the oils while increasing their affinity for metal surfaces.

Due to the work of petroleum technologists the superior lubricating quality of paraffin oils can be had along with the desired ability to flow freely at temperatures as low as minus 30 and 40 deg. F. This desired quality is obtained by the addition of paraflow. Paraflow is a product of the research laboratories of one of the large development companies and was first offered in the fall of 1931.

Diesel Engines

In their paper "The Generation of Power in Industry by Diesel Engines Using Heavy Fuel Oils," J. H. G. McConechy and K. E. DeRosay reviewed the development of diesel engines and emphasized the necessity of using comparable fuel in them as in oil-fired steam plants if the oil engine is to maintain its advantages. In the opinion of the authors, the diesel industry and the petroleum industry are mutually interested in the problem of diesel fuels and diesel-fuel specifications and methods of testing are being studied.

The economics of oil refining make it desirable that diesel fuels be not restricted to the refined distillate class since these materials are the refiner's principal source of cracking stocks for gasoline manufacture. Cracking operations are probably going to increase in the future and it is desirable that the diesel does not compete with the gasoline market for adequate fuel supplies.

Diesel manufacturers are realizing this condition and are directing their energies to designing diesels that can satisfactorily burn cheaper grades of fuel oil of which adequate quantities are produced more or less as by-product materials in gasoline manufacture.

Numerous diesel installations are now operating on these residual lower cost fuels at the present time without difficulty. Their service records compare most favorably with other prime movers and the lower cost of fuel oil further emphasizes the advantages of diesel economy.

Diesel Applications

For generating electric power, providing the main units in marine propulsion, driving pumps or driving widely separated special machinery, either stationary or mobile, the diesel engine is the ideal prime mover. When not required during idle periods, diesel operating costs are at a minimum. As the load develops, the engine can be started up immediately from cold and load applied. This particular feature makes the diesel engine a valuable unit in the electric power transmission system to carry peak loads in conjunction with purchased power to eliminate demand charges.

Although the diesel engine offers the most efficient means of converting heat into useful work, there still remains approximately two-thirds of the total heat content of the fuel that is wasted through the jacket water and exhaust gases. By the use of waste-heat boilers it is possible to recover much heat from the exhaust gases which would otherwise be dissipated into the atmosphere. The temperature of the exhaust varies from 300 to 700 deg. F. with engine type, and boiler units can be obtained to produce hot water or steam at 15, 50 or 100 lb. working pressure with feed water temperatures of 60 deg. F. to 160 deg. F. Where the supply of water is abundant the water discharged from the engine cooling system can be used to advantage as boiler feed water.

In the opinion of the authors, the slow-speed engine can be safely guaranteed for a period of over twenty years.

The maximum rates per annum for fixed charges on the over-all investment, were given as: cost of money 7 per cent, taxes and insurance 2 per cent, depreciation 3.02 per cent.

Power cost with diesel engines was placed at $0.004 to $0.008 per kw.-hr., including the cost of a full-time operating crew. In the discussion it was pointed out that waste-heat boilers were not very attractive when the temperature of the gases is below 1,000 deg. F., which fact worked against using waste-heat boilers on diesels.

Steam Turbine Plants

Some very significant findings were brought out in a paper, "Superimposed Steam-Turbine Generator Plants for the Steel Mill," by A. G. Darling. It was shown that in 30 years steam pressures in industrial steam power plants have increased from around 200 to over 1,200

lb. gage and steam temperatures from 500 to 900 deg. F. Attention was called to the new 110,000-kw. and 15,000-kw. units being installed by the Ford Motor Co. to operate at 1,200 lb. and 900 deg. F. and the 10,000-kw. unit being installed by the Firestone Tire & Rubber Co. to use 1,250-lb., 750-deg. steam.

Turbines of ten years ago are still efficient machines, but in modern high-pressure steam plants about 25 per cent more heat can be recovered than in the old plants. Results were given of studies made to determine the possibilities of rehabilitating old steam plants by superimposing a high-pressure unit on them.

In one plant operating at 225 lb., and 525 deg. F., steam temperatures having five 7,500-kw. units installed and a 24,000 kw. load it was found that by superimposing a 1,200 lb., 825 deg. F. unit on the plant a reduction of $330,000 per year could be realized in the fuel cost. Attention was called to three other cases where the savings were equally significant.

SCHEDULED MAINTENANCE

of Hydro-Plant Equipment

AT THE annual convention of the Canadian Electrical Association at the Log Chateau, Quebec, June 13-15, W. G. Williams, general superintendent, Gatineau Power Co., Ottawa, Ont., presented a report, "Scheduled Inspection and Maintenance of Hydraulic Plant Equipment." The part of this report dealing with maintenance is here given.

Reports received from operating companies indicate that the majority find a certain periodic recurrence in many demands for maintenance work. The information arranged in this article is designed to reflect the average of experience as to these periods. Maintenance work to be done is largely a question of expense involved in comparison with the financial benefits to be derived, and each case will represent different factors that govern the decision.

Surge Tanks, Shafts and Concrete Siphon Spillways: Metal surge tanks may require painting over the alternately wet and dry area at intervals of four to five years, and entire tank interior may require repainting at intervals of eight to ten years. Unlined rock shafts may require scaling down every four years for safety and lined shafts may require attention to lining material at about the same interval. The latter also applies to concrete siphon spillways. Siphon spillways may require removal of debris after flood periods or after lumber drives.

Intakes and Racks: Generally, racks require a thorough cleaning and painting every four years to minimize deterioration. Daily inspection for loss of head through the racks and semi-annual cleaning of debris is general, but depends on steam conditions. Special inspections after floods carrying debris and after lumber drives are suggested.

Penstocks, Tunnels and Canals: For penstocks and tunnels see notes as to surge tanks and shafts. Canals may require some replacement or reconditioning of revetment materials and, possibly, action to do away with undue silt deposits. In the colder climates concrete pipe lines may require repair work at intervals of four years.

Dams and Concrete: Little can be said of the frequency of repair necessary. Action to be taken is indicated by conditions in each case.

Emergency Gate, Forebay and Tailrace Sluicegate: If kept out of water, may require painting about every eight years. If given considerable use, being alternately wet and dry, places may require repainting in four years. Wood seals, etc., require fairly frequent repairs when gates are frequently in service. Roller trains for Stoney-type gates may require attention annually or bi-annually.

Wooden Stoplogs: Useful life of stoplogs may vary from five to thirty years, depending on frequency of change from wet to dry condition, on condition of piling for drying, and on kind of service. Long life is secured by piling with air spaces about each log and by covering when dried out and held idle for use. Pockets which may trap water in stoplogs should be turned down when piling for drying. Much shorter life of stoplogs is obtained if used by lumbermen for driving with logs passing over. Preservation by creosote would appear warranted.

Stilling Wells: Actual repair work required as for materials in other services, In most cases require annual removal of accumulated trash.

Stream Conditions—Ice, Trash, Silt and Matter in Solution: The writer included this item in the inspection schedule only with some hesitation, but decided it should be included to indicate the need of records of changing stream conditions. Ice and trash conditions, as compared with previous years, may be stated approximately in report, and if possible reason given for changes noted. Tests for silt and matter in solution may be made monthly and average results for the year recorded annually.

Headgate and Inlet Valves: Work necessary to maintain tightness is indefinite. May require repainting at four-year intervals and a small amount of mechanical repair at indefinite intervals. Greasing of guides, rollers, etc., is done semi-annually. Seals of butterfly valves require attention at intervals, the period depending on type of seal, frequency of use of the valves, and degree of water tightness required to be maintained.

Pressure and Sump Tanks: May require cleaning of dirt and rust every two years and at four-year intervals interior painting with red lead and a bituminous paint.

Water Piping and Valves Generally: Inspections show leaks or corrosion, but failures are comparatively rare. Outside painting is required at intervals depending on conditions, and cleaning of rust internally at intervals of five to ten years under bad-water conditions.

Governor Oil and Oil Passages: Inspections show need of replacement to cover leakage losses and conditions of oil as to sludging and contamination. Inspection of oil passages in governors shows need for cleaning, renewal of oil screens and filters, at certain periods. (Oil tests, for viscosity, emulsification, etc., are standardized; Osborne, "Power Plant Lubrication"—McGraw-Hill).

Governors Cylinders, Pistons, Rings, Rods, Stuffing Boxes: Taking up of stuffing box packing or its renewal required at long intervals. Scoring of rods is infrequent occurrence that may require attention. Undue cylinder wear unusual, replacement of rings necessary at long intervals. Annual inspection check on tightness of piston and rods and on accumulated wear.

Governor Pumps, Impellers, Bearings, Housing, Couplings, Drives, Unloading Devices: Complete overhaul may be necessary each four years with replacement of necessary parts—thrust shoes, gland sleeves, etc., and relining of bearings. Thrust shoes may require annual adjustment and unloading devices may require annual adjustment and replacement of parts.

Oil Piping and Line Valves, Generally: See water piping and valves above.

Inlet Valves, Pumps Complete, Pressure Switches, Tanks: For pumps and tanks see similar units above. Pressure switches may require calibration annually and repair work at four-year intervals.

Sluicegate and Headgate Hoists, Cranes and Gantries: Repairs to hoists, such as relining of bearings, alignment of shafting, care of couplings, etc., depends on conditions and varies widely in the cases reported. Need a thorough greasing twice per year.

Hoist Chains: Chains in frequent use bearing heavy loads require annealing annually for greater safety.

Temperature Indicators: May require yearly calibration.

Pressure Gages: Require yearly or semi-annual calibration if subjected to severe sudden pressure changes or extreme vibration.

Hoist Cables: Generally, if outdoor, should be thoroughly greased twice a year, fall and spring; if indoor, grease yearly. Life indefinite and inspection designed to reveal wear that unfits cables for further service.

Spare Parts in Store: A check with spare parts list for plants and a check of condition of each article at semi-annual inspection would appear to be advisable. A thorough check to make sure the article is suitable at the time of receipt is advisable.

Scroll-Case Settings and Drainage: Cleaning out of flumes and settings may be required yearly. Scroll cases may require repainting yearly to bi-annually at certain points. Cleaning out of drains may be necessary yearly to bi-annually.

Relief Valves: May require annual adjustment. Life of parts indefinite.

Guide Vanes, Spindles, Lubrication, Bushing, Stuffing Boxes, Pins and Nuts, Etc.: Guide vanes may require adjustment for wear of parts annually, or from distortion of parts by reason of trash caught in gates when closing at indefinite periods. Stuffing boxes may require renewal of packing at one to one and one-half years and bushings or spindles may require replacing in five to eight years, depending on conditions of service. Pins and nuts may

require replacement or tightening at indefinite intervals. Spindle lubrication may require thorough inspection annually, forcing grease through ducts until it is forced through bearings, thus indicating clear passage. Cleaning of some ducts necessary at each inspection as a rule.

Runners, Pitting, Cracks, Clearances and Seal Rings: Pitting of runners requires building up by welding with metal about each two years in many cases. Cracks require welding at indefinite intervals as revealed by inspection. Adjustment to maintain proper vertical clearance may be necessary annually or more frequently. Seals may require fairly frequent attention if water contains much silt.

Hub Keying: Very rare cases of loose keying.

Main Shaft Deflection: Frequency of adjustment depends on conditions in each case. For adjustable guides a limit of 12 mils is suggested, 20 mils for fixed guides.

Cover Plates, Drainage and Bolting: Bolting may require tightening, or, after long intervals, replacement. Rust damage is common. Drainage troubles usually clear up without any particular trouble by removing clogging material while unit is in operation.

Guide Bearings and Stuffing Boxes: Adjustment of guide bearings may be necessary each year and rewooding of lignumvitæ bearings each four years. Main stuffing box may require repacking each two years, and packing added annually. Where very clear water is used in sufficient quantity for lubrication of the bearings, wear is greatly reduced. Bearings under these conditions have operated 12 yr. without appreciable wear.

Governor Piping and Line Valves, Gate Shafts and Bearings; Gate Arm Pins and Bushings, Setting of Servo-Motors: For piping and line valves see water or oil piping and valves above. Replacement of pins and bushings generally necessary only at long intervals. Gate shaft bearings may require relining each four years, and lubrication may require special attention annually. Belt drives may require tightening weekly with new belts; annually with old belts. Life of good belt from five to ten years. Life of gear drive indefinite, but wooden inset teeth may require adjustment annually or more frequently. Settings of servo-motors give almost no trouble, but inspection necessary to guard against possible loosening.

Inlet Valves (Auxiliaries) Actuator Piping and Valves: See above for similarly used apparatus.

Inlet Valves, Hydraulic Cylinders, Pistons, Rods and Stuffing Boxes: See above for similar apparatus on governor systems.

Inlet Valves, Arms, Pins and Bushings, Locking Pins and Pin-Shearing Gears: See above for arms, pins, bushings, etc. Locking pin gear may require replacement of cables about each five years, and cable tightening annually or more frequently. Pin-shearing gear for emergency use should be tested annually.

Air Compressors, Piping and Valves: Regular maintenance as required for type of machine in use. See above for piping and valves.

Brakes and Brake Control: Very little wear except on brake shoes, average life of which would appear to be five to eight years. Brake-piston linings may require renewal in four to six years. Tests for piston leakage annually as a rule. Hydraulic and air controls give almost no trouble.

Water-Elevation Gages: Test semi-annually for condition, fall and spring as a rule. Daily check for accuracy would appear to be general.

Shifting Rings and Links, Pins, Bushings, Nuts, Etc.: Replacement of links to cover breakage depends on operating conditions. See above for pins, bushings, nuts, etc., used in connection with governors.

Governor-Restoring Mechanism: May require slight adjustment quarterly. Dashpots cleaned and filled with fresh oil semi-annually as a rule.

Safety Rails and Platforms: Looseness and breakage found at times. Monthly inspection and repair of defects probably necessary for safety.

Governor Heads: Cleaning required generally each two months and slight adjustment semi-annually.

Governors, Tachometers and Gate-Position Indicators: Cleaning and oiling monthly and check for correct indication monthly are general conditions.

Governor Pilot Valves: Clean valves, chambers and parts monthly, slight adjustment required semi-annually to annually, are common conditions.

Inlet-Valve Position Indicators: See above for gate position indicators.

Violation of Safety Rules Bars Damage for Injury

By LESLIE CHILDS

GENERALLY speaking, where a power company promulgates and enforces safety rules, they will be binding upon its employees. It follows that a willful violation of such rules by an employee will usually be held sufficient to deny the latter a recovery in damages for injury that results from the violation.

Needless to say, each case of this kind must necessarily be decided in the light of its facts and circumstances, and whether or not a safety rule has been willfully violated will usually present a question of fact. However, as an example of the application of the foregoing rule, and the reasoning upon which it is founded, the following decided case may be reviewed with interest and profit.

Disobeys Safety Rule

Here the defendant, a corporation, maintained both light and power lines carried on the same poles and extending into a certain village. The light wires operated at 110 volts, the power wires 2,300 volts, and the poles were concrete.

One T., an experienced and expert electrician, was employed by the defendant to do line work, and among his duties was to replace lights that burned out on the village line. When T. commenced work, his chief went over the line with him, instructed him as to his duties, and informed him of the necessity for cutting off the power before working on the light lines.

After T. had been employed about one month, he commenced working upon a line one morning, without having first pulled the switch. While so employed his head came in contact with the high-voltage wire, controlled by the switch he had neglected to pull, and immediate death ensued.

Following this, his dependent sister filed a claim with the state Industrial Commission for compensation. The defendant opposed this on the ground that T.'s neglect to obey the safety rule amounted to "willful misconduct" under the law, and precluded any recovery of damages for his death. The commission, however, awarded compensation. From this an appeal was taken, and the court in reviewing the record and in reversing the award, in part, said:

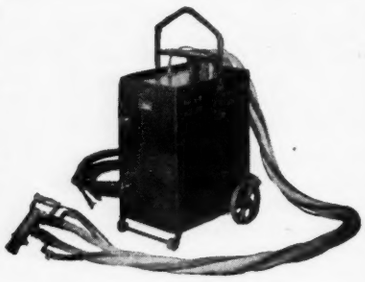
"He (T.) had been told, time and again, by two of his superior fellow servants, and another of the company's electricians, of the existence of the rule, or the importance of heeding it, and of the almost inevitable effect of a failure to do so. He had been instructed specifically as to the method of safeguarding himself. In addition, he was an experienced electrician. * * *

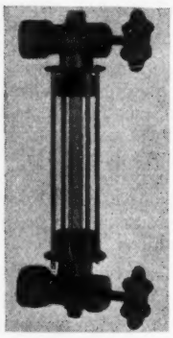
"It is * * * urged that the rule regarding the safety methods necessary before working on the poles was promulgated verbally and was not strictly enforced. It is true that the rule was not printed and posted, but that is only one method of notice, and seems not to be obligatory. As to the latter contention, it seems not to be justified by the evidence. Four witnesses * * * testified of the existence of the rule and that it was strictly enforced, and this testimony is uncontradicted. * * * It is noteworthy that the only infraction of the rule which the evidence discloses resulted in the discharge of the person who violated it. * * *

"It has been held that a rule promulgated by an employer, under circumstances similar to those here, and in a similar connection, has the effect of a statute. * * * If the employee knows the rule, and yet intentionally does the forbidden thing, he has 'willfully failed to obey' the rule. It is not necessary for the employer to show that the employee, having the rule in mind, determined to break it; it is enough to show that, knowing the rule, he intentionally performed the forbidden act. * * * In accordance with the views herein expressed, we reverse the award * * * and hold that the claimant is not entitled to recover." (171 S.E. 261).

The foregoing case was carefully reasoned by the court, and the holding appears to be in accord with the great weight of authority on the point involved. This authority takes the position that a willfull violation of a safety rule by an employee precludes a recovery in damages for the resulting injury.

WHAT'S NEW IN PLANT EQUIPMENT





Motor-Belt Tension Control

"American" base is used for flat-belt drives on short centers, maintaining correct belt tension, avoiding normal deleterious effects of stretch. Belt tension is always in proportion to load, increasing tension under peak loads and decreasing it as load is reduced. Wall, floor, ceiling or upward driving. Utilizes reaction torque, or force of motor opposite to that of its shaft (which of course varies directly with load being transmitted), because motor is suspended in cradle free to rotate in limited range. Pivot axis of cradle is close to motor axis to obtain maximum reaction effect, yet far enough away so that as motor swings it increases center distance enough to compensate for belt stretch and to vary tension with load. Avoids excessive belt tension and consequent shortening of belt life and possible burning out of bearings. Will handle intermittent loads without vibration. Saves on power required. Drive at any angle throughout 360 deg. Charts provided show correct installation. Pressed steel construction. Booklet.

American Pulley Co., 4210 Wissahickon Ave., Philadelphia, Pa.

Portable Stud Welder

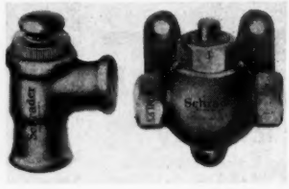
Welding transformer and control in portable steel cabinet, primary and secondary cable and stud-welding gun. Used for fusing stud-ends into metal surfaces for hanging piping, conduits, instruments, etc., by single-shot welding. Control panel inside double doors in cabinet; opening upper door automatically removes power from panel so that adjustments of current and time are made with this door open. Lower door for servicing only. Twenty-ft. double-conductor drag cable leads to power source. Heavy current at low voltage goes from transformer secondary to gun through hollow, forced-air-cooled flexible cables. Transformer secondary also air-cooled to permit reduced weight. Unit complete weighs 500 lb. Welding gun holds stud against work under spring pressure, is aluminum and handles studs from $\frac{1}{8}$ to $\frac{5}{16}$ in. in diameter and $\frac{1}{2}$ to $2\frac{1}{2}$ in. long. Timer adjustable from $\frac{1}{12}$ to $\frac{5}{8}$ sec., varying with stud diameter. For single-phase power supplies, 25-60 cycles, 110-550 volts.

General Electric Co., Schenectady, N. Y.

High-Power Blower

Jumbo portable cleaner, can be used for blowing, sucking, or spraying. Has 1-hp. GE motor, giving water column lift of 46.25 in. Fan diameter $2\frac{1}{2}$ in.

Ideal Commutator Dresser Co., Sycamore, Ill.



Compressed-Air Valve Controls

At left is Schrader No. 7796 industrial blow valve with standard $\frac{1}{4}$-in. female tapered I. P. threads. Can be set up for hand or foot control or with intermittent blast device. At right is No. 7854 for heavy-duty work. May also have lever operating from one of holding-bolt holes. Body cast brass, parts replaceable, washers oil and wear-resisting, deflators work easily, large air passages.

A. Schrader's Son, Inc., Brooklyn, N. Y.

Automatic Liquid Gage

Fig. 1183 now has all working parts—stem, gland, retaining ring, stuffing box, washers and ball checks—stainless steel to resist corrosion and avoid sticking. New rating 350 GLP (gas-liquid pressure) at 450 deg. F. Heavy construction, automatic closure of ball checks on both valves in event of glass breakage, easy replacement of glasses, cone-shape packings around glass, reduced fire and accident hazard, standard pipe plug in lower valve body for drain connection. Unit Parkerized. Booklet F-586.

Lunkenheimer Co., Cincinnati, Ohio.

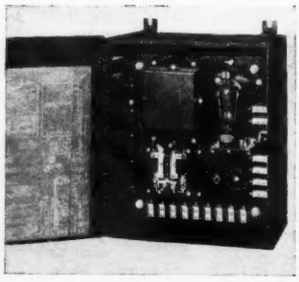


Photo-Electric Controllers

Actuating impulse need be only 1/5000 sec. and from phototube, delicate contact or control circuit. Units to maintain response indefinitely or for adjustable predetermined length of time. RR-O photo-roller is simplest and uses single Grid-Glow tube to operate contactor, solenoid or similar device. Either increase or decrease in illumination may be used to cause tube to pass current. Maximum number of operations for electronic equipment, neglecting time lag in mechanical equipment, is 5,000 per min. RR-1 uses amplifier tube and rectifier tube, giving same power but greater sensitivity than RR-O. Modification called Type RR-1A has additional relay for handling larger load and operates 1,000 times per min. max. RR-3 operates to 25 times per min. Each unit comprises panel assembly on which are mounted tube sockets, transformers, resistors and other parts enclosed in cabinet. Terminals and knockouts.

Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

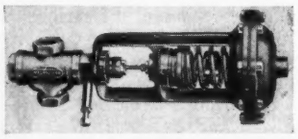
Relief Valve

For industrial use, this unit is available in six sizes with two pressure ranges. Model V pressures 5 to 35 lb. Model VH 35 to 100 lb., difference being in springs. Sizes $\frac{3}{8}$ to $1\frac{1}{4}$ NPT. Formed like tee fitting and mountable in any position. Compact assembly with relief pipe at right angles to inlet and outlet. Valve adjustable by removing hexagonal cap and tightening or loosening check nuts. Spring compartment vented to valve body proper to insure positive action. Many parts common to several sizes.

Tuthill Pump Co., 131 West 63rd St., Chicago, Ill.

Pressure-Reducing Regulator

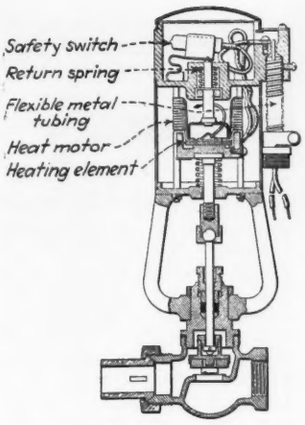
No. 505 series regulators have non-corrosive stainless steel ball bearings rolling up and down with valve stem and turn freely under spring adjusting screw to permit easy pressure settings. Flexible multiple springs permit use of larger diaphragms and are claimed to increase accuracy and sensitivity of regulation. Self-aligning spring button prevents spring tilt and side sway from interfering with operation. Have "centroguide valve," in which valve plug is centrally guided at top and bottom of valve body to lessen wire drawing and cutting of plug and seat rings. Grease-sealed stuffing boxes if desired. Bulletin.



Mason-Neilan Regulator Co., 1190 Adams St., Boston, Mass.

Heat-Motor Valve

The Engineer (London) describes these heat-motor valves, suitable where snap-acting valves are not necessary. Time to open or close 3-5 min., energy consumption (even if valve is permanently closed) 17 watts per hr. In normal working consumption is less. Mica-insulated heating resistance used to heat volatile liquid in bellows. Vapor pressure thus developed



expands bellows and closes valve. Current supplied to heating element through thermostatic switches in room or tank in which temperature is to be held constant. Mercury switch embodied in design automatically opens heater circuit when valve has closed and only switches on heat as necessary to keep valve closed, thus saving current. This switch (at top in cut) is in series with thermostatic switch, consequently if latter opens closing of mercury switch does not permit current to flow through heat-motor heating coils. Thus liquid cools, bellows contracts and valve opens. Mercury switch in circular bakelite box. One ft. flexible metallic tubing with 2 wires. Voltages up to 250 a.c. or d.c. Silent, and cause no water hammer.

Drayton Regulator & Instrument Co., Ltd., West Drayton, Middlesex, England.

Endless Rubber Belts

Plylock belt joint, perfected by Fred G. Skeyhan, avoids tendency of outside seams to open in severe service. Seam is imbedded or countersunk below surface to relieve it from strain and shield it from wear or windage. Protection provided by thick cushion of rubber reinforced with bias fabric vulcanized in position. To be licensed.

B. F. Goodrich Co., Mechanical Rubber Goods Division, Akron, Ohio.

Improved Thrustor

Now complete range giving 10 combinations of thrust and stroke ratings from 50 to 3,200 lb. thrust and 2 to 16 in. stroke

in this self-contained combination of motor-driven centrifugal pump, oil chamber and piston. Impeller housing of centrifugal pump now stationary, rigid shaft running in ball bearings connecting impeller and motor. Driving motor totally enclosed, a.c. or d.c. For single-phase service, capacitor motors used on thrustors with over 100 lb. thrust. For 25-cycle service, special step-up gear train. For 50-cycle supply, slightly larger impellers. Interchangeable base plates for clevis and rigid mounting permit tilting as much as 45 deg. from vertical. Also designed for continuous operation with piston in stalled position.

General Electric Co., Schenectady, N. Y.

Coated Welding Electrode

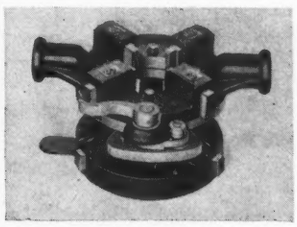
Electrodes for arc-welding high-carbon and high-strength steels known as "Murex special A." Hinders migration of carbon from parent metal to deposited metal and gives more ductile deposit. Sound, dense, clean welds. Deposit contains some nickel and has tensile strength of 73,000 lb. per sq. in. Other electrodes give strengths to 85,000 or 100,000 lb. per sq. in., obtained by adding nickel or molybdenum or both.

Metal & Thermit Corp., 120 Broadway, New York, N. Y.

Pipe Tools

No. 200 Beaver swivel pipe reamer reams $\frac{1}{8}$ to 2-in. pipe. Handle and knob malleable iron; reamer alloy steel heat-

treated. Can be resharpened and replaced when worn out. No. 70 and 72 Series diestocks will not mar pipe; have wide range, no loose bushings, and fully adjustable. Will thread iron, steel, wrought iron, brass, copper or aluminum pipe with standard, undersize or oversize threads and throwout avoids die resetting and backing off. Segmental type dies easily resharpened. Each set of dies



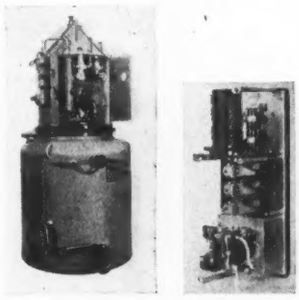
threads two sizes (except $\frac{1}{8}$). Stock malleable iron. No. 70 threads either $\frac{1}{4}$ to $1\frac{1}{4}$ or $\frac{1}{2}$ to $1\frac{1}{4}$. No. 70 R (ratchet) same ranges. No. 72 series handle up to 2-in. pipe.

Borden Co., Warren, Ohio.

Portable Acetylene Generator

Oxweld Type MP-4 unit has capacity of 150 lb. of quarter-size carbide. Listed as standard by Underwriters' Laboratories, Inc., and rated to produce 300 cu.ft. of acetylene per hour. Weight 750 lb. empty, 2,250 lb. fully charged. 87 in. high, $42\frac{3}{4}$ in. diameter. Gravity type feed, self-contained in carbide hopper. Feed valve diaphragm actuated, diaphragm being under pressure by spring loading to deliver gas at 13 lb. per sq.in. External adjustment varies range up to 2 lb.

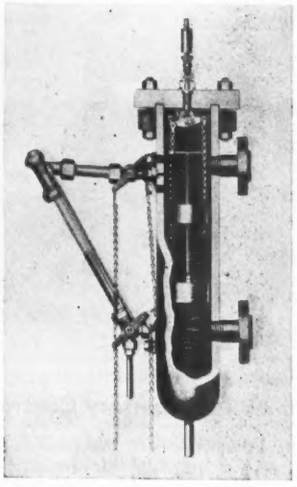
Linde Air Products Co., 30 E. 42nd St., New York, N. Y.



Synchronizing Relay

Automatic compensation for errors due to source voltage difference and control-voltage variations is featured in this synchronizing relay. Unit is positive and quick-acting. Essential element is an advance transformer operating through a pair of thermionic (electron) tubes to control auxiliary relays so that breaker closure is initiated with proper advance time, according to operating time of breaker, to effect breaker closing near exact instant of true synchronism. May be used for either machine synchronizing or line synchronizing, in either automatic or manual stations. Case $5\frac{1}{2}$x16 in. universal type, with auxiliary box $9\frac{1}{2}$x17 in, behind panel on relay studs. One cable for connections.

General Electric Co., Switchgear Division, Philadelphia, Pa.



Improved Water Column

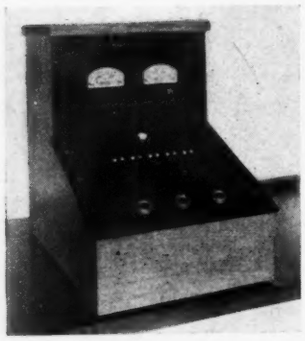
Yarway floatless Hi-Lo alarm water column and Sesure-Inclined water gage now improved in design. Now smaller, lighter water column body; simpler, more flexible and more responsive operating mechanism for Hi-Lo alarm; inclined connecting member at top of gage, which drains back condensate that might otherwise collect at this point and cause erosion and corrosion of glass. Still has these features of older models: balanced solid weights working on displacement principle to operate whistle alarm at high and low water levels, attachment of gage valves directly to water column with chains set well back from gage glass for clear vision and to prevent strain on glass, inclined gage glass for easy reading from below. Working pressures to 1,500 lb. For pressures to 250 lb., water column cast iron, higher pressures water column cast steel. Tubular gage glasses for pressures to 400 lb., above that flat glass inserts. Latter has offset condensate groove which carries condensate down alongside glass.

Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

Plastic Insulation

Non-metallic, micaceous material very light in weight and of high insulation value used as aggregrate. Specially tenacious binder. Coverage of 1,400 sq.ft. to the ton applied 1 in. thick. Adheres to metal or brick. Conductivity at 200 deg. is 1.0, volume shrinkage from wet to dry 10 per cent. Average wt. applied 16 lb. per cu.ft. Suitable up to 1,700 deg. F. and reclaimable where temperature has not exceeded 1,200 deg.

Wyolite Insulating Products Co., Division of Wyodak Chemical Co., Cleveland, Ohio.



Small Supervisory Control

Polaricode Jr. low-cost control is suitable for industrial plants and combines raise-lower control with simultaneous telemetering indication of position for distant control of variable-position apparatus — valves, rheostats, tap changers, etc. Operates minimum of five apparatus units, only two telephone type wires being required between dispatching point and remote station. Cabinet 14 in. wide, 21 in. deep, 20 in. high.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

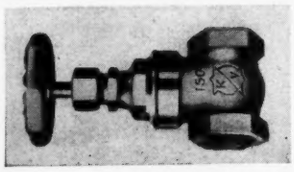
Insulating Fire Brick

G-25 controlled insulating fire brick is manufactured under patented process scientifically controlled at every stage. Is highly porous brick with numerous non-communicating cells, having density of 42 lb. per cu.ft. Claimed to have lowest conductivity of any insulating fire brick in its price range, and to withstand spalling. Suitable for use under oil, gas or electric-firing, for temperatures up to 2,500 deg. F., where slagging or severe abrasion is not encountered. It is claimed that because of its reflecting characteristics, furnaces may be brought up to temperature in one-fifth of time, and fuel costs may be cut as much as 50 per cent. Made in 9-in. series and packed 20 bricks to the carton.

A. P. Green Fire Brick Co., Mexico, Mo.

Heavy Standard Bronze Gate Valve

Designed for 150-lb. working steam pressure and 250-lb. working water, oil or direct gas pressure, this valve, known as Fig. 23, has all features originally incorporated in Kennedy Fig. 27 standard unit, but is heavier throughout. Large bonnet hex placed close to body makes entire valve more rigid and also permits easier removal of bonnet and stem assembly in close quarters. Stem of tough bronze with larger number of heavy

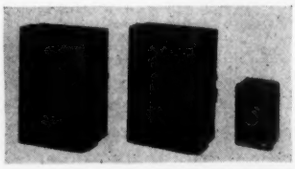


contact threads, and with flexible connection between stem head and disk. Deep stuffing box with graphite molded packing rings, bronze gland and heavy packing nut. Non-heating, non-slipping hand-wheel and heavy pipe-end hexes. Complete range of sizes up to 3 in.

Kennedy Valve Mfg. Co., Elmira, N. Y.

Automatic Motor Starter

This across-the-line starter meets underwriters' requirements and prevents accidental starting. Red stop button extends around and beyond green start button. Full advantage of motor capacity is permitted by inverse time-limit protection which allows carrying a small overload long time or very heavy load short time. Immediate motor starting upon resumption of current is insured by low-voltage release with two-wire control. Furnished in three types. XLA starter for 3 and 5 hp., 110 volts; also 3, 5, 7½ and 10-hp. at higher voltages. XLB starter for 7½ and 10 hp. at 110 volts; 15, 20,



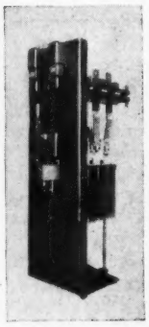
25 and 30 hp. at 220 volts; 15, 20 and 25 hp. at 440 volts, and 15 and 20 hp. at 550. XLBB for 30-hp., 440 volts, and 25 and 30 hp., 550 volts.

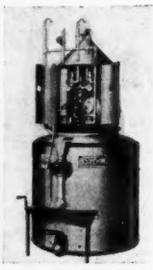
Lincoln Electric Co., Coit Road & Kirby Ave., Cleveland, Ohio.

Self-Supporting Panels for Small Circuit Breakers

These self-supporting steel panels for mounting small oil circuit breakers for insolated installations are suitable for use on ungrounded systems up to 2,500 volts. Oil circuit breaker interrupting ratings are 20,000 to 50,000 kva. Requires no assembly of apparatus or adjustment of breaker or mechanism. Consists of isolated flanged steel panel, to which supporting feet have been welded, so that panel, when fastened to floor, becomes self-supporting. In addition to breaker and operating lever, accessory apparatus, such as current transformers, relays, etc., can be mounted. Metal guard available which will inclose back of equipment from top of breaker tank to top of panel.

General Electric Co., Schenectady, N. Y.

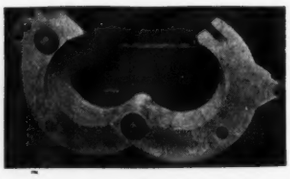




Stationary Acetylene Generator

Oxweld Type MP-5 will deliver 1,000 cu.ft. of acetylene per hr. at medium pressures. Feed control unit self contained, bolted to inside of carbide hopper. Feed valve unit actuated by diaphragm. Gravity type feed. Preloaded spring (set at 13 lb. per sq. in. at factory) exerts pressure on one side of feed-control diaphragm. Large carbide and water doors, residue valve and handhole. Removable hopper.

Linde Air Products Co., 30 East 42nd St., New York, N. Y.



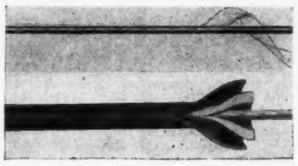
Electric Weld-Stress Reliever

This equipment will normalize welded joints from 6 to 24 in. in diameter, in pressure piping. Jointed rings of various sizes are provided to fit pipes, and power is supplied for a special transformer which, with necessary control equipment, is mounted on a hand-truck. Induction heat is applied to areas to be relieved. Speed, cleanliness and precise control are claimed.

Detroit Electric Furnace Co., 825 Elizabeth St., West, Detroit, Mich.

Cellophane Insulation

Two new insulations worked out with cooperation of DuPont Cellophane Co. include "Cellophane"-covered magnet wire, and "Duprene"-covered



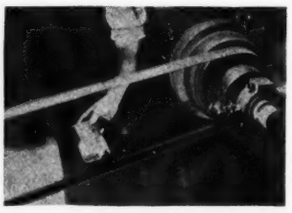
ignition cable. Former, named Celenamel, is produced by wrapping "Cellophane" over adhesive-covered magnet wire, then lacquering and baking. Increased dielectric strength and about same space factor as silk enameled wire and much less than cotton-covered wires. Protects enamel insulation against heat and varnish solvents. Ignition cable, called Belden 7799, has special orange rubber compound core and thin jacket of "Duprene," a rubber substitute which resists high heats, hot oil, and decomposing effects of corona.

Belden Mfg. Co., 4647 West Van Buren St., Chicago, Ill.

Variable-Speed Motors

Varidrive motor now has Synchrogear within self-contained housing to provide operator with infinitely variable speed range. Take-off shaft supported by bearing housing machined to fit companion machined surface of Varidrive case. Heavy ribbed construction avoids strains on these single-reductions. Squirrel-cage, asbestos-protected motor integral with speed changer utilizing varying effective diameter of driving disks. Bulletin.

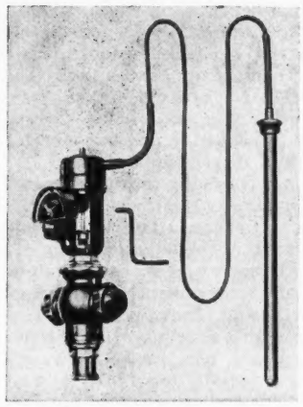
U. S. Electrical Mfg. Co., 1501 South Western Ave., Chicago, Ill., or 202 East Slauson Ave., Los Angeles, Calif.



Liquid Belt Dressing

Rubber belt dressing which softens only surface and does not penetrate belt proper. Easy to apply; increase pulley grip and horsepower delivery.

B. F. Goodrich Co., Mechanical Division, Akron, Ohio.



Temperature Regulator

No. 943 self-contained temperature regulator has graduated dial and pointer operates through standard temperature range of 100 deg. F. Adjusted by removable crank, one turn changing regulator setting 10 degrees. Allen-head lockscrew operable only by wrench incorporated in crank prevents tampering with setting. Dial has easily readable markings and space for special markings. Thermal bulb in variety of sizes and materials to suit application. Operates on vapor-expansion principle with all-metal seamless Sylphon bellows for motor element. Standard temperature ranges: —30 deg. F. to 70 deg., 0-100, 50-150, 100-200, 150-250, 200-300.

Fulton Sylphon Co., Knoxville, Tenn.

Bucket Trap

"Titan" trap in 4 sizes, pressures to 300 lb. per sq.in. "Tiny" in 2 sizes, pressures to 150 lb. per sq.in. High capacity and compactness obtained with lever in top of trap so bearings will be in clean water protected from wear by scale and grit. Unaffected by pulsating pressures, no wire-drawing, handles air and other noncondensable gases. Discharge intermittent under low medium loads, continuous under high loads. Open bucket is source of power for opening and closing valve. By means of lost motion between valve and lever, sudden complete opening and quick tight closing obtained. Oil or grease floating on condensate does not affect operation. Adaptable to change in pressure by changing seat. Mechanism removable without taking trap from line.

Nason Mfg. Co., 71 Fulton St., New York, N. Y.

Breaker

Type H "Sentinel" breaker in single- or double-pole types protects against burnouts. Completely enclosed in molded case; only operating handle exposed. Combination bi-metal and auxiliary heater and proper proportioning of parts gives self-protection. Resetting of thermal latch by moving breaker handle. Nineteen thermal element ratings from 1.4 to 14.2 amp. for motors of 1.1 to 12.9 amp.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Open Fuse Cutouts

Complete new company line of open fuse cutouts with drop-out fuse-holders, so that suitable ratings may be chosen for all distribution circuits up to 15,000 volts; these three units all fusible from 1 to 100 amp. are rated at 5,000, 7,500/12,500Y and 15,000 volts, with interrupting capacity of 1,200 amp. (R.M.S.) Two other units, previously announced, can be fused from 1 to 60 amp. at 7,500/12,500Y and 15,000 volts, with an interrupting capacity of 1,200 amp. (R.M.S.). Both sizes have drop-out feature, fuse-holder removable with standard switch hook and automatic latch.

General Electric Co., Schenectady, N. Y.

NEW BULLETINS

Lighting — Hygrade Sylvania Corp., Salem, Mass. Pocket-sized folder containing convenience list of recommended foot candles for industrial interiors, commercial interiors and outdoor lighting, together with tables of light absorption of colors on ceilings and walls and in transparent and translucent glass.

Welding Corrosion-Resistant Steels — Linde Air Products Co., 30 East 42nd St., New York, N. Y. Eight-page booklet 8¼ by 11 in., illustrated, "Oxwelding Corrosion-Resisting Steels." Gives recommended practices based on this company's laboratory investigations.

Insulated Cable — General Electric Co., Schenectady, N. Y. 80-page reference book GEA-1837, "How to Select Insulated Cable," includes data on cable for transmission and distribution of electric power at normal frequencies, showing two methods of selecting conductor size, various types of insulation and finish, tables of thickness, wire gages, dimensions, sizes of shipping reels, and bibliography.

Expansion Joints — American District Steam Co., North Tonawanda, N. Y. Eight-page Bulletin No. 211, covering ADSCO piston-ring expansion joint for continuous service, recently described in *Power*.

Welding—Lincoln Electric Co., Cleveland, Ohio. One-page bulletin, "The Importance of Proper Selection of a Protective Welding Lens," describes new Lincoln "Super-Visibility" protective lens for welders, now available in two shades.

Centrifugal Blowers—Roots-Connersville Blower Corp., Connersville ,Ind. Four-page Bulletin 120-B10 describes single-stage centrifugal blowers and exhausters. Capacities up to 8,000 c.f.m. at pressures up to 3 lb.

Gate Valves — Jenkins Bros., 80 White St., New York, N. Y. Unique 12-in. cut-out replica of standard iron body gate valve, providing exact reproduction of both exterior and interior mechanism of the heavy valve. Other pages list features of design and construction and point-by-point comparison.

Maximum Demand Controllers — Esterline-Angus Co., Indianapolis, Ind. Four-page Bulletin No. 534, "Keep Down Power Bills," shows the advantages of lowering and controlling maximum demand. Also two-page Form 429, "Save Time and Trouble by Using These Handy Devices," showing small units for auxiliary use with meters and electrical instruments.

Hoists—American Hoist & Derrick Co., St. Paul, Minn. Two new bulletins, 16-page "American Equipment," and 12-page "American Eagle Crane," describe hoisting and derrick equipment manufactured by company.

Temperature and Humidity Control — Barber-Colman Co., Rockford, Ill. New loose-leaf folders containing all company's data sheets on its electric system of temperature and humidity control.

Air-Conditioning — Lewis Air Conditioners, Inc., 829 Second Ave., South, Minneapolis, Minn. Six-page catalog announcing new line of air-conditioning equipment, and announcement of opening a special department giving engineering service on heating and air-conditioning layouts.

Pyrometers — Illinois Testing Laboratories, Inc., 141 West Austin Ave., Chicago, Ill. Two new bulletins. Bulletin 1726 illustrating and describing "Alnor" Pyroll pyrometer for measuring surface temperatures of revolving rolls or driers, and Bulletin 1727 discussing "Alnor" Pyrocon combination pyrometer and Type 1755 pyrometer for measuring surface temperatures of flat surfaces.

La Frigocentrale Sulzer. Sulzer Bros., Ltd., Winterthur, Switzerland. U. S. representative, David Dasso, 50 Church St., New York, N. Y. An exceedingly well-printed 37-page 9 x 12-in. book showing Sulzer refrigerating units. Statistical data, cross-sections, and necessary information on typical insulations, etc.

Check Valves. Williams Gauge Co., 1620 Pennsylvania Ave., N.S., Pittsburgh, Pa. Four-page bulletin, H.C.V. 13, illustrating and describing the Hager flanged noiseless check valve.

Test Ammeter. Columbia Electric Mfg. Co., Cleveland, Ohio. Six-page bulletin on instant current measurements with Crompton "Tong Test" ammeters.

Welding. Lincoln Electric Co., Coit Road & Kirby Ave., Cleveland, Ohio. Thirteen-page bulletin, "The Shielded Arc," describing its method of welding and its advantages.

Power Factor Improvement. General Electric Co., Schenectady, N. Y. Fourteen-page GES-1012, "Here's Proof That Power-Factor Improvement Reduces Power Costs."

Laminated Bakelite. Synthane Corp., Oakes, Pa., has issued a pocket-size Laminated Bakelite sample book illustrated with reproductions of sheet rods, tubes, fabricated parts and possible machining operations on this material, including actual samples and data and similar information on facing pages.

Pumps. Viking Pump Co., Cedar Falls, Iowa. Short article on page 10 of the June, 1934, number of "Viking Vacuum" describes pumps for wineries and distilleries.

Electric Motors. Imperial Electric Co., Akron, Ohio. Four-page Bulletin 1040, "Why You Should Buy from the Little Fellow," shows reasons why small manufacturers of electric motors can render distinctive types of service.

Air Conditioning. Sturtevant Cooling & Air Conditioning Corp., Hyde Park, Boston, Mass. Catalog No. 398, "Air Conditioning for Comfort," illustrates and describes typical installations of this company's equipment.

Vibrating Screens. Link-Belt Co., 910 South Michigan Ave., Chicago, Ill. Sixteen-page illustrated catalog No. 1462 describing vibrating screens for coal and coke in a variety of types.

Impact Pulverizers. Whiting Corp., Harvey, Ill. Eight-page bulletin No. 13 describes air separation impact pulverizers, showing types, specifications and applications.

Hygrometers. Brown Instrument Co., Philadelphia, Pa. 28-page catalog No. 6501 describes Brown hygrometer for recording and controlling humidity, illustrates latest models, explains various operating principles.

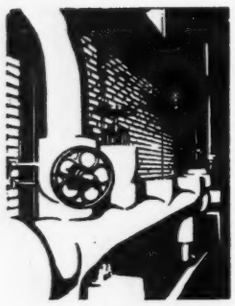
Packings. Johns-Manville, 22 East 40th St., New York, N. Y. 49-page catalog describes and illustrates 60 types of this company's packings.

Boulder Dam. Babcock & Wilcox Co., 85 Liberty St., New York, N. Y. 17-page Bulletin S4-A describes the Boulder Dam project and elaborately illustrates the penstock piping being built by B. & W. for this project.

V-Belt Drives. Dayton Rubber Manufacturing Co., Dayton, Ohio. 16-page catalog No. 150 describes V-flat drive in a complete range of sizes for ratings up to 300 hp., or more, and for use in general industrial service where large speed ratios and very short centers are involved. The V-flat drive differs from regular V-belt drives in that the large pulley is flat instead of grooved.

Speed Reducers and Gears. D. O. James Manufacturing Co., Chicago, Ill. 95-page Catalog No. 137 describes continuous-tooth speed reducers and gears. Illustrates installations with data and specifications.

Calcium Chloride. Michigan Alkali Co., 10 East 40th St., New York. 48-page catalog on Wyandotte calcium chloride for safe refrigeration, including a large amount of necessary data.



POWER LINES

Twenty-five Hundred Attend N.A.P.E. Meeting

ABOUT 2,500 power-plant engineers and their friends attended the 52nd Annual Convention and Power-Equipment Exhibit of the National Association of Power Engineers at Minneapolis, Minn., Aug. 27 to Sept. 1. Registration included about 200 N.A.P.E. delegates and 150 delegates of the Ladies' Auxiliary. Headquarters were the Curtis Hotel and Minneapolis Municipal Auditorium.

This year's power-equipment exhibit was under N.A.P.E. control instead of the Exhibitors' Association as in previous years. About 200 manufacturers were represented. Holding the meetings and entertainment features in proximity to the power exhibits, on the same floor, proved to be a desirable combination, for it centered interest at one location.

The convention was opened Tuesday morning, with Conrad A. Nelsen, general chairman, presiding. A welcome to the State of Minnesota and the City of Minneapolis was made by representatives of Gov. Floyd B. Olson, Mayor A. G. Brainbridge and William Welsh, Minneapolis Chamber of Commerce Association. Response to these were made by John A. Prudell, national president; George M. Diebold, national vice-president, and A. F. Thompson, national past-president.

Pres. John A. Prudell officially opened the convention and presented his report. After reviewing the work of the Association for the last year, President Prudell made 14 recommendations for extending the work of the Association. An increase of about 2,600 in membership was reported for his year in office. In regards to membership in the Association, President Prudell said:

"We are convinced that with improvement in employment and business there will come to the Association a greater interest and a return of those members who temporarily have found it necessary to withdraw; also there will be found a large field for new memberships. What has thus far been accomplished under unfavorable conditions towards strengthening our ranks gives great encouragement for the future."

He also presented his appreciation of the work of the local committee by saying:

"The members of the Local Convention Committee, headed by Chairman Con Nelsen, are to be highly commended for their work done during this year. Their united cooperation and effective work with us has resulted in a most successful convention and mechanical exhibit. For this cooperation, this harmonious blending of all groups towards a common goal, we wish to extend our sincere thanks and appreciation."

A new feature of this year's convention was an 8-page daily newspaper which appeared on Tuesday for the first time, under the title of the "National Engineers Convention Daily," published under direction of T. G. Thurston, editor of "National Engineer."

At the Wednesday morning session, Prof. B. J. Robertson, University of Minnesota, presented a paper on diesel engines. Prof. Robertson illustrated his subject by many lantern slides and explained how this type of engine operates, and the different types of diesel engines that have been developed, discussed their field of application and the kinds of fuel used. In closing he predicted that the engineer of the future is likely to be called upon to operate both steam and diesel engines.

Speaking on Thursday morning's program, Prof. Charels A. Mann, Chemical Engineering Division, University of Minnesota, told how the utilization of waste of both farm and forest through the efforts of the chemist is producing new products and conveniences. He explaned how the development of new ideas on fuel use, new kinds of water softeners, new metals and metal alloys have simplified and aided the power-plant engineer in his work.

On Friday morning at the last session, it was voted to hold the 1935 convention in Pittsburgh, Pa.

Officers elected for the coming year are: President, George M. Diebold, Buffalo, N. Y.; vice-president, Richard A. Free, Chicago, Ill.; past president, Joseph A. Prudell, Milwaukee, Wis.; secretary, Fred W. Raven, Chicago, Ill.; treasurer, Edward J. Burke, Pittsburgh, Pa.; conductor, Charles Belmore, Worcester, Mass.; doorkeeper, Walter White, Los Angeles, Calif.; trustee, Conrad Nelsen, Minneapolis, Minn.

World's Steam Experts Dine; Orrok Honored

With America as host, steam physicists from overseas were guests at the dinner of the Third International Steam Table Conference at the Hotel Astor, New York, N. Y., Sept. 19. The A.S.M.E. was sponsor. Alex Dow, A.S.M.E. past president, president of Detroit Edison, chairman of Special Research Committee on the Thermal Properties of Steam, presided. Dr. Harvey N. Davis, Stevens Institute president and himself a steam physicist, was toastmaster.

American speakers included Col. Paul Doty, A.S.M.E. president; Arthur M. Greene, Jr., engineering dean at Princeton; Dexter S. Kimball, Cornell dean. Foreign speakers were Henry L. Guy (Great Britain), Prof. G. H. Henning (Germany), I. V. Robinson (Great Britain, but speaking for Czechoslovakia). The Unversity Quartet entertained the 200 delegates and guests, including many ladies.

To George A. Orrok, "grand-dad" of the nearly complete 13-year American

Delegates and friends at the 52nd N.A.P.E.

steam research program, was awarded a silver dish, inscribed:

"In tribute to Geo. A. Orrok, engineer, whose vision, energy and enthusiasm promoted the union of science and engineering by bringing together, in the spirit of James Watt and Joseph Black, the research workers of the world to determine the thermal properties of steam. Presented with the warm affection and sincere admiration of the participants in the Third Steam Table Conference, New York City, N. Y., September 19, 1934."

In the days before the dinner the Conference had met in Washington and Boston. Following it several days of technical sessions were held in New York. International steam-table tolerances were greatly narrowed. Foreign delegates entertained the Americans with a return dinner at the Waldorf-Astoria Hotel.

Metals Meeting in New York

The National Metals Congress and Exposition is being held in New York at the Hotel New Yorker and the Port of Authority Bldg., 15th St. and Eighth Ave., at the time this number goes to press, with a number of national societies cooperating, including the A.I.M.E., A.S.M.E., A.W.S. and A.S.M. More than 150 exhibitors are showing their products at the Exposition.

A.S.M.E. sessions include papers on non-ferrous metals and iron and steel. American Welding Society is holding its 14th Fall Meeting, which will include a number of papers especially for power engineers. Other society meetings deal more specifically with metals. Among plants holding open house during the meeting are the U. S. Navy Yard, C. J. Tagliabue and International Nickel.

Prime Mover Manufacturing Data

Employment increases in the manufacture of engines, turbines, tractors, water wheels and windmills in the United States in 1933 from a total of 20,407 wage earners, reported for the first quarter in March, to 27,001, reported for the fourth quarter in December, according to a preliminary tabulation of data collected in the Biennial Census of Manufactures taken in 1934. The value of total production of this equipment in 1933 was $75,966,225 in plants engaged primarily in this line of manufacture, a decrease of 56 per cent as compared with $172,677,421 reported for 1931, previous census year.

Principal items for 1933, and their values, are: Steam engines and turbines, $5,013,229; diesel and semi-diesel engines, $5,161,489; other internal-combustion engines, $23,160,359; water wheels and turbines, $448,863; windmills and windmill towers, $1,661,134.

NRA Codes

Among the recent codes published by the NRA is Amendment No. 2 to Approved Code No. 38 for the Boiler Manufacturing Industry, Supplement No. 40 to Approved Code No. 347 for the Diesel Engine Manufacturing Industry, Approved Code No. 493 for the Industrial Oil-Burning Equipment Manufacturing Industry, all available from the Superintendent of Documents, Washington, D. C., at 5 cents a copy. The Steel Tubular and Fire-Box Industry Code Authority has proposed amendments to the industry's code providing for a budget and basis of assessment. The Warm Air Furnace Pipe and Fitting Manufacturing Industry has submitted a budget to cover code administration expense. Dexter A. Tutein, Philadelphia, has been appointed representative of the retail solid fuel trade on the NRA General Code Authority, which will supervise administration of the industries coming under the "basic" code.

Refrigerating Machinery Assn.

Refrigerating Machinery Association will hold its annual meeting Oct. 22 at the Stevens Hotel, Chicago, according to an announcement by W. S. Shipley, president. Included in the program will be papers on new developments, standardization, promotion of high standard of trade practices, and similar material. Officers will be elected and activities planned for the coming year. Offices of the association are 915 Southern Bldg., Washington, D. C.

Included in the program of the International Acetylene Association, to hold its annual meeting at William Penn Hotel, Pittsburgh, Nov. 14, 15 and 16, are "Metallurgical Aspects of the Oxy-Acetylene Welding Process," "Pipe Welding and Testing" and "Education and Safety in Welding." Further information from H. F. Reinhard, secretary, 30 East 42nd St., New York, N. Y.

Claude Starts Out With Floating Ice Plant

Georges Claude, inventor of the neon light and experimenter with energy drawn from the ocean, has completed a floating ice factory, mentioned in *Power* some months ago. The 10,000-ton steamer *Tunisia* has been fitted out and is now on her way to Rio de Janeiro, where Mr. Claude awaits her. A half-mile tube will be hung overside from the vessel, to bring cold water from the depths. The process consists of making warm water from the surface of tropical seas boil by introducing it into a vacuum, utilizing the vapor to run turbines, and then condensing it with cold water drawn from the depths. The plant is expected to produce 1,000 tons of ice a day to be sold in Rio. Equipment cost $198 a kilowatt, or about $435,600 total, but Claude says that larger plants would cut the cost to $66 a kilowatt, "making the source of energy the most economical now existing, and the cost of the ice about one-fifth the present price."

Fuel Oil Standards

The Standing Committee on Fuel Oil (identical with Section 1 of Technical Committee C, A.S.T.M. Committee D-2) has approved certain changes in the Commercial Standard on Fuel Oils, CS12-33. Detailed requirements are given in a table and are somewhat changed, as are methods of tests for carbon residue and ash.

Power Show

Plans are steadily progressing for the 11th National Exposition of Power and Mechanical Engineering to be held at Grand Central Palace in New York, Dec. 3-8, at the time of the annual meeting of the A.S.M.E. Exhibits now under construction are coordinated to emphasize the savings in power costs.

Smoke Abatement Exhibit at Century of Progress

Until Oct. 31, the Chicago Smoke Abatement Fair Exhibit in the General Exhibits Bldg. at the Century of Progress Exposition will be open for those interested in fuel economies. Competent engineers are available to demon-

Convention in Minneapolis, Minn., Aug. 27-Sept. 1

strate and discuss not only proper firing methods and progress in smoke abatement, but to point out to the statistical trend surrounding the changing fuel conditions of the coal-consuming group, types of fuels, and correct and incorrect equipment. Included in the exhibit are hand-operated models of stokers, steam jet showing advantage of firebox turbulence, electrical charts setting forth meteorological effects on air pollution, an electrical "coal-tree" showing by-products obtained from coal, electrical demonstrations of firing high- and low-volatile coals, dust-testing apparatus, display showing how fires should be built and refueled, smoke densities of department stores, breweries, hotels, power stations, homes and apartments, machines for testing solids and smoke in stacks, fire-boxes or breechings, smoke recorders and photo-electric smoke indicators. Visitors are taught how to read smoke and how dust from the air is trapped and scrubbed. There is also an exhibit showing the effect of smoke pollution on health and a series of moving pictures showing causes of smoke pollution and the results of the recent Chicago work.

So far more than two million persons have either studied or observed this display, and another half million are expected before Oct. 31, when the Fair closes.

National Power Survey

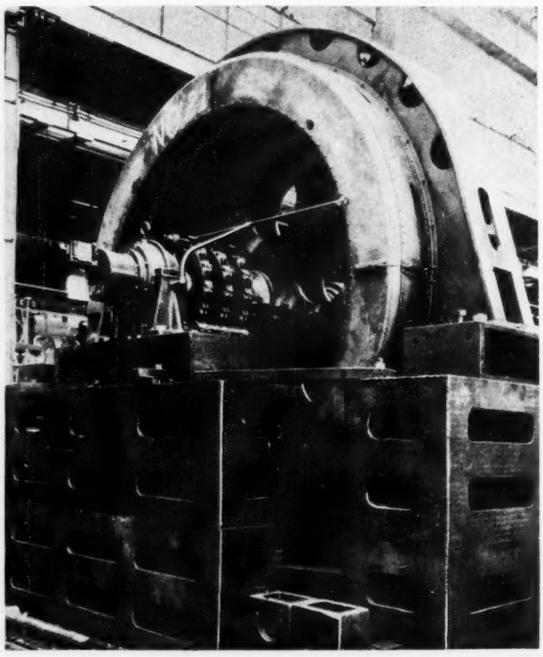
The Federal Power Commission is now entering upon the most important phase of the National Power Survey of the "water resources of the United States as they relate to the conservation, development, control and utilization of water power, of the relation of water power to other industries and to interstate and foreign commerce; and of the transmission of electrical energy in the United States and its distribution to consumers," Vice-Chairman Basil Manly, in charge of this survey, has announced.

"Schedules for the information desired have been developed after long study and consultation with utility executives and public authorities, and are being sent out to power companies and municipal plants throughout the country," Mr. Manly said. "The schedules are comprehensive but no unnecessary questions are asked. Everyone concerned recognizes the need for this survey. It is no academic study, but an urgent practical undertaking. Determining the nation's power requirements, and how they can be most economically and advantageously supplied is the primary purpose. Markets must be considered, as well as power sites that can be developed at reasonable cost, either by governmental enterprise or private capital.

"Water-power development, while the major objective because of the Federal government's direct interest, is not the only element. Proper utilization of steam and diesel plants is also being given the most serious consideration. One purpose of the survey is to establish and maintain that balance between steam and hydro-electric power which will give America the most dependable sources of energy at the lowest possible rates."

The survey will include a detailed engineering analysis of the data collected, and of all available information concerning power resources and requirements. Reports will cover all generating plants, both steam and hydro-electric. Maps are requested showing location of power plants, reservoirs, transmission lines and sub-stations.

Thomas R. Tate is director of the National Power Survey; Lester S. Ready, chief consulting engineer, and the division chiefs are: power requirements, Percy H. Thomas; power resources, Eric H. Mees; distribution, George H. Morse; research, Fayette S. Warner.



One of the 2,500-hp. motors for Fort Peck Dam on test at the G.E. Schenectady shops

21 Big Induction Motors for Fort Peck Dam Project

Twenty-one big wound-rotor induction motors for dredge pump and booster pump drives on the Fort Peck dam project have been shipped by the Schenectady works of General Electric Co. for the project on the Missouri River in eastern Montana. The pump motors are rated at 2,500 hp., 6,600 volts, 60 cycles, three-phase, 257 r.p.m. There will be two on each of four dredges, two on each of four floating booster stations, and one in each of four land booster stations. One of the 21 motors is a spare. In addition, G. E. has built and shipped five 700-hp., inclosed, externally force-ventilated waterproof induction motors for driving dredge cutters, and five 150-hp. induction motors for driving the winches. Booster stations will pump mud and water from the dredges through several miles of pipe line to the dam site. The mud and water mixture will be used to form the hydraulically earth-filled core of the dam, which, when completed, will contain 68,000,000 cu.yd. of material, or approxmately 80,000,000 tons. In order that dredge pump motors and booster pump motors on the same line will divide load properly, a liquid slip regulator has been provided for each motor, which will automatically hold load substantially constant at any given setting by changing motor speed.

Committee of Ten Meets

The Committee of Ten, Coal and Heating Industries, held a regular meeting at the Medinah Club, Chicago, Sept. 12. It was decided to hold the annual meeting in November, and to invite all persons interested in committee activities and in marketing and utilization of solid fuels. After a discussion on the Government's hydro-power program, motion was passed instructing the secretary to prepare a general resolution for signature of all organizations, delegates of the committee, condemning the Government's entry into competition with private business in the power field, and supporting the stand taken by the National Coal Association. Marc G. Bluth was advanced by resolution from assistant secretary to executive secretary, and will represent the committee at the annual meeting of the National Coal Association that is to be held in Washington, D. C., this month.

A.I.E.S.E.E. Officers

New officers of the Association of Iron & Steel Electrical Engineers recently elected include:

President, W. H. Burr, mechanical and electrical superintendent, Lukens Steel Co.; first vice-president, J. A. Clauss, chief engineer, Great Lakes Steel Corp.; second vice-president, G. R. Carroll, elec. supt., Jones & Laughlin Steel Corp.; director-at-large, C. A. Thayer, chief engineer, Republic Steel Corp.; honorary directors, J. Farrington, elec. supt., Wheeling Steel Corp., and E. Friedlander; past presidents, W. E. Miller, mech. & elec. supt., Bethlehem Steel Co., and J. D. Donovan, mech. & elec. supt., Republic Steel Corp.; treasurer, W. S. Hall, supt., engr. & constr., Illinois Steel Co.; secretary, A. D. Adams, asst. supt., Spang Chalfant Co., Inc.; managing director, John F. Kelly, Empire Bldg., Pittsburgh, Pa.

PLATFORM

Reprinted from "Business Week" Sept. 22, 1934

POWER *is not a political publication. Its job is to help engineers everywhere in their constant efforts to improve power services and cut power cost in* their own plants—*not to direct the national forces of economic and social evolution. Occasionally, however, a political trend is of such vital business importance to every citizen as to warrant some attention even in a technical journal. For that reason we have devoted some attention to N.R.A., particularly in its early months when policies and precedents were rapidly taking form. Today American business faces another turning point, when public opinion, particularly the opinion of industrial men, seeks intelligent guidance. For that reason we publish here this* Business Week *editorial which, we feel, is honest and intelligent and free from those partisan passions which so frequently mark the utterances of extremists on both sides of the fence.*—EDITOR.

This is a political year. The fact ought constantly to be borne in mind. Yet, so insidious are the effects of political agitation, there is no one of us who can preserve unclouded judgment through the pervasive fog of propaganda. With a last remaining shred of realism, we see that business facts are better than business sentiment, concerned though men properly may be over alarming trends.

Amplified, this is to say that business is not so much disturbed by what the government has done so far; it is deeply apprehensive that trends already discernible may be developed too far and too fast; that the Administration may make good its radical threats and promises.

Well, there is a promising remedy. There probably never before has been a President so keenly sensitive to the trend of public opinion—or one who responded to it so promptly. Public opinion in this country, real public opinion, is not to be confounded with the political froth now on top of the wave. True sentiment can be brought out.

It seems to us that the sensible procedure is this: Make all due allowance for the imminence of Congressional elections—allowance which includes liberal discount both of opposition propaganda, and of Administration gestures to conciliate radical elements. Then, relying upon the political sagacity of the government in power, prepare to make the sober judgment of business men in general unmistakably apparent in Washington before the new Congress meets.

Some there are (prominent, too) who would like to set the clock all the way back to the "standard time" of the 'twenties. Sympathize with them if you will, but be practical. Discard their advice. Never, in all history, has it been possible to restore the "status quo ante."

We suggest a platform for business—not complete as here presented, but a beginning:

1. There is high salvage value in NRA. If industry be permitted to operate its codes under the original concept of self government, and can secure the necessary enforcement of compliance, there still is hope that this first effort of the New Deal will add materially to recovery.

2. Collective bargaining is accepted. Also minimum wage and maximum hours. But government encouragement of a labor leadership that has not proved its worthiness must cease.

3. The business man will back with all his resourcefulness and all his courage every phase of the New Deal which means—

   a. Relief to those who are in want.

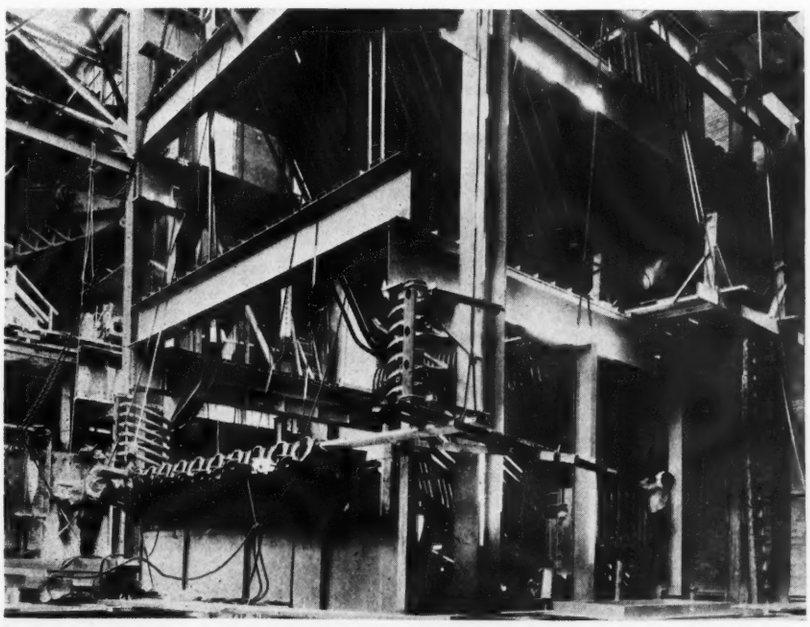
   b. Recovery, to the end that there will be no need for relief.

   c. Those Administration measures which will bring about a better stabilization of employment, a fairer distribution of profits among labor, management, and capital.

   d. Those measures which will help prevent the abuses of the past.

4. Business men will oppose the perpetuation of government operation of business, and the entrenchment of temporary agencies until they become permanent bureaucracies.

It is being said that business is on strike—that it would cheerfully scuttle the recovery program to sink the New Deal. This is preposterous. Business men have little political interest; their primary interest is business. No one wants prosperity more earnestly than the business man, no matter who brings it; no one is working harder for it. Revive the original spirit of partnership, and the New Deal will have a powerful ally in business.



WESTINGHOUSE BOILER PLANT UNDER CONSTRUCTION

Construction on the new boiler house and the first of a group of four boilers is well under way at the East Pittsburgh Works of Westinghouse Electric & Mfg. Co. When completed, this first 16,000-sq.ft. boiler will be used for plant process and heating purposes and will be capable of operating at pressures up to 600 lb. Building and boiler are being constructed at a cost of $400,000.

OBITUARIES

Michael Henry Broderick, founder and president of the Broderick Co., Muncie, Ind., died Sept. 1 there.

Earle P. Bishop, for 20 years mechanical engineer on the staff of United States Shoe Machinery Corp., at its Beverly, Mass., plant, died recently at his home in Swampscott, Mass.

Robert Henderson, international representative of the Boiler Makers, Iron Ship Builders and Helpers, and for 30 years active in labor matters relating to steam plant equipment manufacturing, died at his home in Brighton, Mass., Aug. 23.

J. R. McNiece, chief engineer of Rainier Heat & Power Co., Seattle, Wash., and with that company for 32 years, died there Aug. 24.

William MacFarlane, for 35 years associated with Union Belt Co., Fall

River, Mass., in various capacities, and for several years general manager of the concern, died at his home in Fall River, Sept. 6.

W. S. Martin, former treasurer of the Mead-Morrison Mfg. Co., Boston, Mass., and well known in power-plant engineering circles in the New England area, was killed in an automobile accident Sept. 14 near Montpelier, Vt.

George B. Page, Philadelphia district manager for Terry Steam Turbine Co., Hartford, Conn., formerly employed by B. F. Sturtevant Co., New York, N. Y., and Rust Engineering Co., in Pittsburgh, died in Philadelphia Sept. 10.

E. J. Rosencrans, 63, founder and president of Business Journals, Inc., 192 Lexington Ave., New York, N. Y., which publishes "Motorship" and "Diesel Power," died Sept. 8 after a short illness.

Robert W. Armstrong, Jr., for many years stationary engineer of the Walker Building, Boston, Mass., died some time since after eight years' residence in Medford.

Howard L. Rogers, 63, for many years vice-president of Stone & Webster Engrg. Corp., Boston, and widely known in the power development field for his executive direction of major construction work of that organization in the hydro-electric and steam engineering fields, died at his home in Chestnut Hill, Mass., Sept. 20, after a protracted illness. He was connected with Stone & Webster as an engineer and later partner from 1893 to 1929, when he retired.

PERSONALS

L. S. Stephens has been elected to succeed D. B. Piersen as president of Stephens-Adamson Mfg. Co., Aurora, Ill. Mr. Piersen, one of the founders of the firm in 1901, was made chairman of the board upon resignation of W. W. Stephens of Pasadena, Calif. L. S. Stephens, the new president, has been in the firm since 1914. In 1921 he was made superintendent and in 1926 vice-president in charge of production.

P. R. Mork has been transferred by Crane Co., 836 South Michigan Ave., Chicago, Ill., from New York to the general office in Chicago, where he will serve as vice-president in charge of sales. He will assume the duties of Vice-Pres. H. W. Seymour, who is on leave of absence due to ill health. P. R. Berryman, formerly vice-president of the Trenton Potteries, has succeeded Mr. Mork as manager of the New York branch and associate branches of the Crane Co. in the metropolitan area.

H. S. McPherson has been appointed manager of mechanical sales in the St. Louis district for the Mechanical Goods Division, U. S. Rubber Products, Inc., 1790 Broadway, New York, N. Y. Mr. McPherson, with the company over 15 years, was formerly in charge of mechanical sales for the Boston district. W. G. Mueller, who has been with the company for the past 25 years, largely in the Connecticut territory, will succeed Mr. McPherson in Boston.

STRAWS

Pointing the way business winds blow

Murray, Utah, has plans under way for extensions and improvements in municipal electric light and power plant, including installation of new 250-kva. diesel-generator unit, with complete accessory equipment, including spray pond, fuel tanks, etc. A fund of $33,000 has been arranged through Federal aid.

Board of Trustees, University of Washington, Pullman, Wash., soon will ask bids for equipment for proposed new power plant for central steam-heating service, including boilers and accessories, feed water treatment apparatus, conveying equipment, mechanical fans, ducts, switchboards, etc. Power house will be 60x100 ft. Ross B. Hammond, Inc., Spalding Bldg., Portland, Ore., has tendered a low bid for the building. Fund of $142,000 arranged through Federal aid. Stanley Smith, Pullman, architect; Charles C. May, superintendent of buildings and grounds.

State Hospital Commission, Indianapolis, Ind., has preliminary plans for extensions and improvements in power plants at State Hospitals at Logansport and Evansville, to include installation of boilers, pumps and auxiliary equipment.

Bureau of Reclamation, Denver, Colo., will receive bids until Oct. 15 for pumping machinery for Boulder dam and power plant, Boulder Canyon project, California-Arizona-Nevada, comprising three motor-driven, deep-well turbine type units, each 5,000 g.p.m.; one similar pumping unit, 1,600 g.p.m.; two portable, motor-driven, deep-well turbine-type units, each 1,500 g.p.m.; 12 gear or screw type, motor-driven, oil pumping units, each not less than 100 g.p.m.; one similar unit of 50 g.p.m. and one of 7 g.p.m.; one portable high-pressure rotary piston pump, motor-driven, with accessories, ½ g.p.m.; 15 water-jet educators; two air compressors of 330 cu.ft. air per min. capacity, each; and one air compressor, 180 cu.ft. per min. rating; two air receivers and four pressure regulators (Specification 595).

Fairfax, Minn., has authorized G. M. Orr & Co., Baker Bldg., Minneapolis, Minn., consulting engineers, to prepare plans for new municipal electric light and power plant, using diesel-generator. Fund of $50,000 approved. Bids soon.

Independence, Mo., soon takes bids for steam power equipment for new municipal electric light and power plant. Plans completed by Black & Veatch, Mutual Bldg., Kansas City, Mo., consulting engineers. Contract for a 3,000-kw. turbo-generator and 5,000-sq.ft. surface condenser placed with Westinghouse at $84,000. Equipment still to be purchased includes boiler feed pumps, air preheater and auxiliary apparatus, piping, etc. Financing for $140,000 arranged through Federal aid.

United States Engineer Office, Pittsburgh, Pa., is asking bids until Oct. 16 for construction of Tygarts Valley reservoir dam on Tygarts River, near Grafton, W. Va., including certain operating mechanism, lighting system, piping and other work. Dam will be 232 ft. high and 1,850 ft. wide, and will be

Battersea Station, England, is installing this generator. This 42-ton stator yoke, 12½ ft. wide by 13 1/3 ft. high, was taken from Manchester to London by rail, two lines being kept clear because of its extra width

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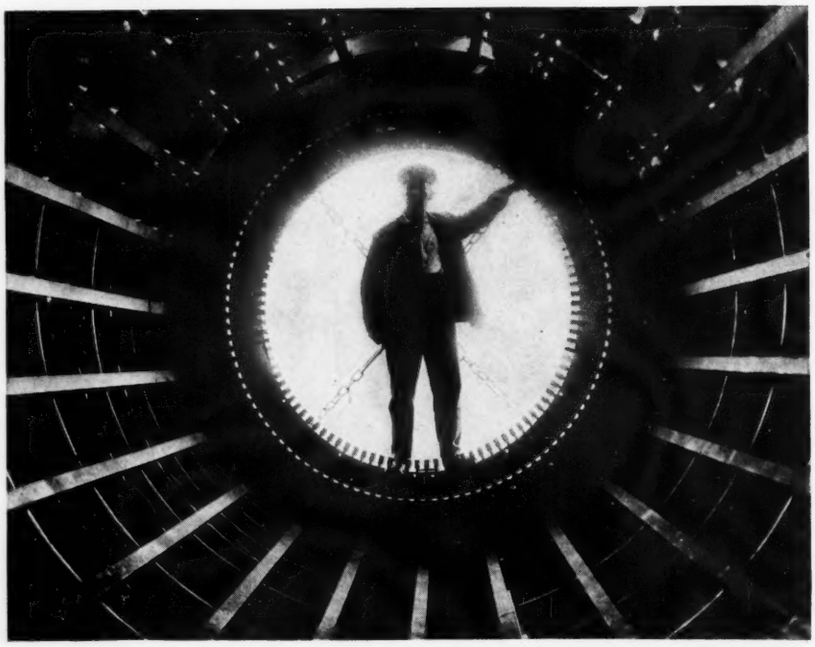

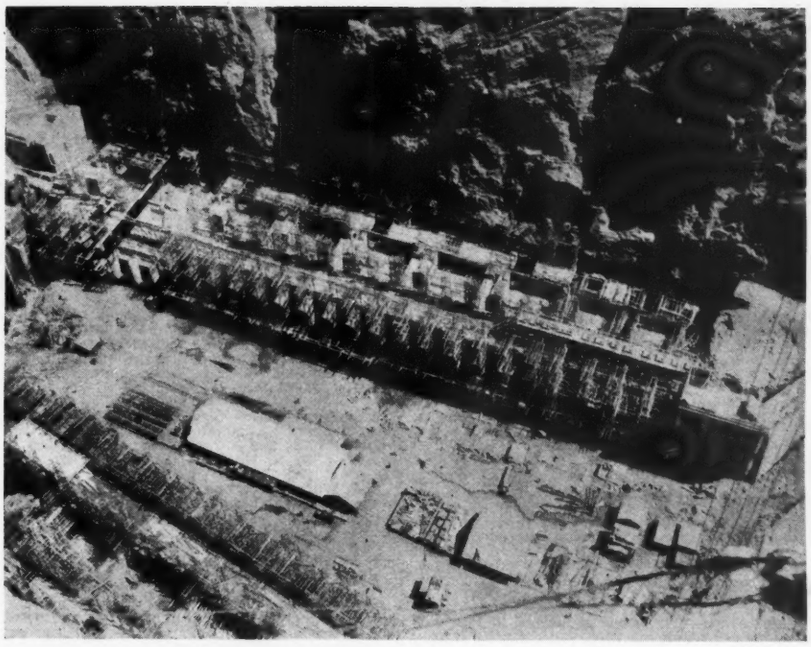

Wide World

Looking directly down 600 ft. from the top of Black Canyon to the Boulder Dam powerhouse, the photographer showed the project as of Sept. 13

used at later date for hydro-electric power. Plans soon in progress. Fund of $10,000,000 authorized.

Northern Natural Gas & Pipe Line Co., Owatonna, Minn., affiliated with Minneapolis Gas Light Co., Minneapolis, Minn., has approved plans for early construction of a new welded-steel pipeline from Rosemount, Minn., to Mendota, where connection will be made with system of gas light company for natural gas supply. Pipeline will include stations for booster and distribution service, and is estimated to cost close to $1,200,000. A. F. Traver is engineer for first noted company.

Sanitary District of Chicago has awarded contracts for prime movers for expansion in power plant at Lockport, Ill. S. Morgan Smith Co., York, Pa., and James Leffel & Co., Springfield, Ohio, will furnish water turbines at $133,490 and $24,514, respectively, while Allis-Chalmers Mfg. Co., Milwaukee, Wis., has orders for two electric-generator units at $185,740 and $17,297.

Cummins Distillery Corp., Detroit, Mich., Walter C. Wagner, Breslin Bldg., Louisville, Ky., architect, in charge, plans installation of steam power equipment in connection with extensions and improvements in former distilling plant at Atherton, Ky. Power house will be remodeled and new boilers, stokers, pumps and accessory equipment installed. Entire program will cost close to $200,000.

Greenville, Miss., has authorized surveys and estimates of cost for new municipal electric light and power plant. Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

St. Cloud, Minn., is arranging for early special election to approve bonds for $1,249,000 for new municipal electric light and power plant, and electric distribution system. Surveys and estimates by Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

Basshead Ale & Brewing Co., Port Huron, Mich., plans installation of steam power plant in new local brewery. Company has been organized recently and has taken over local building, to be converted for new plant. Boilers, stokers, pumps, tanks and other equipment will be installed. Entire project will cost about $150,000, of which close to $100,000 will be used for plant equipment. Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., engineer.

Board of Trustees, Western State College, Gunnison, Colo., has approved plans for new power house for central steam heating service. Installation will include two 280-hp. boiler units, stokers, coal pulverizers, feedwater pumps and auxiliary equipment. Fund of about $50,000 arranged. Prouty Brothers Engrg. Co., Exchange Bldg., Denver, Colo., consulting engineer.

Greenville, Mich., has engaged Francis Engrg. Co., Saginaw, Mich., consulting engineer, to make surveys and estimates of cost for proposed extensions and improvements in municipal electric light and power plant, including installation of new equipment. Report scheduled at early date.

Coshocton, Ohio, has plans under way for extensions and improvements in municipal waterworks, including new steam-operated electric generating plant for power supply, motor-driven pumping units and auxiliary equipment, pipelines, etc. Fund of $164,000 arranged through Federal aid. Begin work soon. City engineer in charge.

Bailey Meter Co., Ltd., Canadian subsidiary of Bailey Meter Co., Cleveland, Ohio, has received an order for 21 recording and integrating steam-flow meters with auxiliary pressure recorders for installation in the Imperial Oil Refineries, Ltd., plant at Sarnia, Ont. Meters will be used to measure steam and to record steam pressure of various departments.

Milwaukee (Wis.) Sewage Disposal Plant is installing an 1,800-ft. line of stainless-clad steel pipe ranging from 2 to 5 ft. in diameter. This construction was used to reduce friction of compressed air through the pipe, for if cast iron had been used, the pipe required would have had to be larger, necessitating expensive changes in buildings. Cream City Boiler Co., Milwaukee, is doing the all-welded job, using "Plykrome," made by Illinois Steel Co.

Cedar Falls, Iowa, has ordered complete coal-handling equipment for its municipal light plant from C. O. Bartlett & Snow, 6200 Harvard Ave., Cleveland, Ohio. Equipment includes track hoppers, skip hoists, overhead bunkers and a weigh larry for handling coal to stokers.

Bailey Meter Co., Cleveland, Ohio, has sold two large adjustable orifices to the U. S. Navy for use in testing aircraft carburetors under actual flying conditions. One orifice will be installed in a 16-in. line, the other in an 8-in. line, carrying air from —60 to +200 deg. F. to carburetors.

Refractory & Engineering Corp., Port Kennedy, Pa., is increasing its plant to increase capacity of the mineral-wool blanket department.

Atlanta, Ga., largest city in the southeast, has moved to secure electric power from TVA.

Seattle Board of Public Works took bids until Sept. 13 for construction of the powerhouse building at Diablo Dam, a portion of the City of Seattle municipal hydro-electric project on the Skagit river.

Santee-Cooper Authority is considering two hydro-electric and navigation projects, one of which may be selected as a basis for approximately $25,000,000 of PWA funds. The proposed plans call for creation of two large reservoirs, Pinopolis and Santee, a little northwest of Charleston, S. C. Pinopolis is to have a 200,000-hp. hydro plant.

GADGET

Coppus Engrg. Corp., Worcester, Mass., is furnishing air compressor and internal combustion engine salesmen with pocket slide-rules to avoid complicated arithmetic in figuring correct capacity of an air filter. It is a celluloid pocket unit containing a sliding chart showing compressor c.f.m. displacement figures on one side and hp. figures for engines on the other, these figures passing slots corresponding to number of cylinders. Separate slots take care of single- and double-acting compressors and 4-cycle and 2-cycle engines.

NEW BULLETINS

Automatic Air Separator—Railway & Industrial Engineering Co., Greensburg, Pa. Eight-page bulletin, "Stuart Automatic Separator," describes this automatic unit recently described in *Power*, gives sizes, specification and installation data, and also it shows the same company's receiver drains and how applied.

Air Hoists—Ingersoll-Rand, 11 Broadway, New York, N. Y. 32-page Bulletin No. 12107 on "Utility" air hoists, describes both single-drum units and double-drum units, the first in ten sizes with capacities up to 2,000 lb., the second in four sizes up to 2,000 lb.

Pulverized Fuel Equipment — Foster-Wheeler Corp., 165 Broadway, New York, N. Y. 24-page Bulletin P-34-2, "Pulverized Fuel Equipment," is highly illustrated and is published as part of the Foster-Wheeler general catalog. It describes in detail the impact mill (aero type) and the Tricone ball mill (Hardinge type). Second half of the booklet also discusses its auxiliary equipment for complete systems.

V-Belt Drive—The Medart Co., Potomac & De Kalb Sts., St. Louis, Mo. 42-page loose-leaf booklet, "Data and Price List on Medart V-Belt Drives," includes complete engineering and purchasing information on all types of multiple and fractional horsepower drives.

Electrical Conduit—Johns-Manville, 22 East 40th St., New York, N. Y. Bound set of engineering data sheets on Transite electrical conduits now available under the title, "Johns-Manville Transite Conduit for the Electrical Industry." The book includes discussion of properties, information on sizes, weights and list prices, details and dimensions, description of installation and specifications.

Out-Voltage Regulator—Roller-Smith Co., 233 Broadway, New York, N. Y. Six-page Catalog No. 10 describes new "Kathetron" Out-Voltage Regulator used to avoid visible light flicker in those cases where starting and stopping of motors or other devices brings about voltage changes.

Worthington—Worthington Pump & Machinery Corp., Harrison, N. J. Two new bulletins, two-page on Worthington multi-V-drive, No. L-400-43, four-page No. W-311-B1, superseding W-311-S1B, on Worthington centrifugal pumps, single-stage volute Type R.

Electric Instruments — General Electric Co., Schenectady, N. Y. Catalog GEA-602D includes 162 pages of data on the line of electrical instruments manufactured by this company, complete description and sizes of specifications.

Speed Reducers—Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. 32-page illustrated Catalog No. 1415 with horsepower and other engineering data, dimension diagrams, etc., covering single-, double- and triple-reduction herringbone gear units, also full line of flexible couplings.

Non-Return Valves — Edward Valve & Mfg. Co., Inc., East Chicago, Ill. 48-page booklet 11-T discusses the desirable characteristics of boiler and non-return valves, shows photographs of notable installations, lists users, includes condensed catalogs.

Testing Welders — Linde Air Products Co., 30 East 42nd St., New York, N. Y. 24-page illustrated booklet, "The Testing and Qualification of Welders," outlines simple tests for measuring the ability of welders, giving the first of six essential steps in every procedure control for oxy-acetylene welding.

Westinghouse—Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Recent bulletins include, two-page illustrated leaflet 72-130, describes Type WH flexible couplings. 12-page Catalog 35-500, describes CM-2 heavy-duty network protectors. Also three new circulars, C-2004, C-2005, C-2206, describe applications of air-conditioning to offices, restaurants and stores and shops. Four-page illustrated folder D.M.F. 5589 describes uses and features of self-contained summer air-conditioner known as "Mobilaire." Four-page leaflet 20620 describes Flexarc Cletrac Welders for construction and maintenance jobs.

Insulating Blocks — Johns-Manville, 22 East 40th St., New York, N. Y. Four-page engineering folder IN-28-A describes the new 1,900-deg. Superex Insulating Blocks and discusses principles of combination installation and gives table of recommended thicknesses.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Calif., Los Angeles—Bids, Oct. 9, by D. P. Nicklin, purch. agt. Dpt. Water & Power, 207 South Bway., furnishing, delivering outdoor, oil insulated self cooled station type distribution transformers **(1)** three 500 KVA, 34,500 V **(2)** three 200 KVA, 34,500 V, **(a)** f.o.b. cars bidders shipping point **(b)** f.o.b. cars or trucks, 1630 North Main St., Spec. 1511.

Calif., Modesto—Bids Oct. 8, by C. S. Abbott, secy. Modesto Irrigation Dist., furnishing, delivering high voltage transformers, Spec. E-20; feeder voltage regulators, Spec. E-21, for Electric Dpt. of Dist.

Calif., Sacramento—Burns & McDonnell Eng. Co., engrs., 107 West Linwood Blvd., Kansas City, Mo., have completed report and will start on plans soon for power plant for Sacramento Dist., c/o A. Given, ch. engr. Est. $20,000,000.

Calif., South San Francisco — Chamber of Commerce compiling estimates of cost of diesel operating electric power plant for report to City Council to operate as municipal project.

Colo., Gunnison—Western State College plans by Prouty Bros., Exchange Bldg., Denver, power plant. $50,000.

Colo., Rifle—City plans election $70,000, for diesel power plant. P.W.A. project. E. Harrison Thwaits, 357 Lafayette St., Denver, engr.

Ill., Chicago—Oct. 4, by H. E. Wallace, acting clk. Sanitary Dist. of Chicago, 910 South Michigan Ave., erecting and installing hydro-electric units with appurtenances and other miscellaneous work for Lockport Power House, Div. E, on Sanitary Dist. Main Channel, 1 mi. south of 16th St., Lockport.

Ill., Waukegan—Alexian Brothers Hospital, c/o Brother Gerard, provincial superior, 1200 Bladen Ave., Chicago, bids in spring, 3 and 4 story, brick, concrete novitiate building, power house and generating plant, $600,000. Maher & McGrew, 1564 Sherman Ave., Evanston, archts.

Ind., Austin — Public Serv. Co., Traction Bldg., Indianapolis, making plans power substation, transmission and distribution lines. $60,000. Private plans.

Kan., Hoistington—City, reports completed and plans bond election soon for complete municipal light plant and distribution system. $150,000. W. B. Rollins & Co., 339 Railway Exch. Bldg., Kansas City, Mo., engrs.

Minn., St. Cloud—City, election Oct. 2, to vote on amendment to city charter enabling city to issue revenue bonds constructing municipal electric power plant and distribution system. If carried, election to vote on bond issue for above project will follow soon. $1,249,000 loan and grant allotted by P.W.A. Burns & McDonnell, 107 West Linwood Blvd., Kansas City, Mo., engrs.

Miss., Greenville — City report in progress municipal power plant and distribution system. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., archts.

Mo., Independence—City, R. F. Sermon, mayor, soon takes bids foundation for 3,000 kw. turbo-generator, building improvements, boiler feed pumps, air preheater and piping. P.W.A. project. Black & Veatch, Mutual Bldg., Kansas City, engrs.

Neb., Norfolk—City making plans electric plant and distribution system. Black & Veatch, 700 Postal Bldg., Kansas City, Mo., engrs.

Nev., Boulder City—Bids Oct. 10, by Bureau Reclamation, Denver, Colo., 2,300 volt switching equipment; four 287.5 kilovolt 3-cycle oil circuit breakers; four 287.5 kilovolt, outdoor type, lightning arresters; twelve 287.5 kilovolt 1,220-ampere 3-hole, motor-operated, disconnecting switches, one 4,000 ampere 23,000 volt bus structure with current transformers, one 2,000 ampere 23,000 volt bus structure, with current transformers; four 600 ampere, 15,000 volt oil circuit breakers; three neutral grounding reactors, with cubicles for installation in Boulder Power Plant, Boulder Canyon Project, Arizona-California-Nevada, Spec. 589.

N. Y., Jamestown—Bureau P. Utilities, City Hall, plans survey to determine need of municipal light plant addition, Steele St. To exceed $28,500. C. O. Johnson, supt.

N. Y., Wellsville—Municipality voted $85,000 for boiler house at municipal water and light plant. G. Esherick, Jr., City Hall, assistant engr. in charge.

N. D., Leeds—City plans municipal electric light and power plant. $45,000. Application for funds filed with P.W.A. T. R. Atkinson, Bismarck, engr.

O., Cincinnati — Cliffside Brewing Co., 242 West McMicken St., plans by Fosdick & Hilmer, power house addition. $30,000 or more.

Pa., Eaglerock — Henry's Bend Community Assn., Henry's Bend (Eaglerock P.O.), P. C. Stubler, pres., 23 Elm St., Oil City, plans electric light and power plant also installing 2 mi. electric transmission lines to serve summer cottages. $28,500 or more.

Pa., New Castle—City Council, C. B. Mayne, mayor, plans $3,750,000 bond election for municipal light and power plant. **Maturity indefinite.** G. H. Hoskins, City Hall, city engr.

Pa., Warren—Borough, R. W. Steber, Burgess, plans municipal light and power plant. C. Barvis, city engr. **Maturity indefinite.**

Tex., Goose Creek—City, election Oct. 20, $50,000, electric power plant. Inland Eng. Co., c/o Owners, engrs.

Tex., Wink—City having estimates made of cost of constructing municipal electric light and power plant, preparatory to submitting proposal to vote of the people.

Utah, Murray—City plans purchasing, installing 250 kva. engine and generator and constructing power house addition. $33,000. P.W.A. loan granted. H. Bledsecker, Magna, engr.

Vt., Brattleboro—Town, Electric Light Comn., A. P. Carpenter, chn., 32 Main St., to decide at town meeting in March, 1935, about municipal electric plant.

Wash., Seattle—Bids Oct. 11, by Bd. P. Wks., G. W. Roberge, secy., electrical equipment and apparatus for Diablo Power House, Skagit Project, 196-230 KV. oil circuit breakers, 196-kv. disconnecting switches, auxiliary metal-clad switchgear, wall bushings, station light, power anjd heat switchboard, distribution panels, cabinets, neutral circuit breakers, rectifier equipment for switch operation, storage battery, battery charging M.G. sets, inverter, oil purifying and testing apparatus, hydraulic metering equipment, telephone equipment and main unit instrument transformers. To exceed $200,000.

Que., Montreal—Power Corp. of Canada Ltd., 335 St. James St. W., plans extensive hydro-development of St. Croix River.

Que., Noranda—Noranda Mines, Ltd., Royal Bank Bldg., Toronto, Ont., has been incorporated to report and if satisfactory to proceed with construction and development of 20,000 hp. power development on Upper Ottawa River for use of Noranda Mines. F. A. Gaby, 480 Spadina Rd., Toronto, Ont., consult. engr.

New Zealand, Wellington—Bids Nov. 27, by Secretary Public Wks., Supplies & Tenders, two 24,000 kva. generators and two 30,000 hp. water turbines.

Australia—Victorian Government, **Melbourne,** preparing plans electrical development and tenders will be called this year; 110,000 hp. Kiewa River Scheme; 188,000 hp. Mitta-Hume Scheme; and 90,000 hp. Snowy River Scheme, est. about $30,000,000***New South Wales Government, **Sydney,** plans harnessing and using for development, the Tooma and Shoalhaven Rivers.

Ecuador, Quito—Bids Nov. 13, by Municipal Engineer, supplying, erecting 2 water turbines each 160 hp. direct coupled to 1,250 kva. alternator, with transformers, cables, street lighting apparatus equipment d.c. generator, etc.

Uruguay—Ministry of Pub. Wks., Montevideo, bids about Jan. 15, hydro-electric plans, on Rio Negro River. To exceed $1,000,000.

Uruguay, Montevideo—Bids Oct. 19, by State Electric & Telegraph Administration, supplying substation equipment, incl. 6,600 volt feeder cubicle, transformers cubicle, and high and low tension switchgear; Oct. 29, 97,500 meters, of lead covered V.I.R. cables of various sizes; Oct. 31, knife rotary and pear shaped switches. Details at nearest Consulate.

Siberia, Krasnoyarsk—Paper Combine, Krasnoyarsk, Siberia, c/o Soviet Government, Moscow, or c/o Amtorg Trading Corp., 261 5th Ave., New York, pulp and power plant with annual capacity 26,000 tons newsprint, 36,000 tons writing paper and 4,000 tons cardboard. Owner will construct by day labor. To exceed $1,000,000.